Transformer visualization via dictionary learning:
contextualized embedding as a linear superposition of transformer factors

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Abstract

Transformer networks have revolutionized NLP representation learning since they were introduced. Though a great effort has been made to explain the representation in transformers, it is widely recognized that our understanding is not sufficient. One important reason is that there lack enough visualization tools for detailed analysis. In this paper, we propose to use dictionary learning to open up these ‘black boxes’ as linear superpositions of transformer factors. Through visualization, we demonstrate the hierarchical semantic structures captured by the transformer factors, e.g., word-level polysemy disambiguation, sentence-level pattern formation, and long-range dependency. While some of these patterns confirm the conventional prior linguistic knowledge, the rest are relatively unexpected, which may provide new insights. We hope this visualization tool can bring further knowledge and a better understanding of how transformer networks work. The code is available at https://github.com/zeyuyun1/TransformerVis.

1 Introduction

Though the transformer networks (Vaswani et al., 2017; Devlin et al., 2018) have achieved great success, our understanding of how they work is still fairly limited. This has triggered increasing efforts to visualize and analyze these “black boxes”. Besides a direct visualization of the attention weights, most of the current efforts to interpret transformer models involve “probing tasks”. They are achieved by attaching a light-weighted auxiliary classifier at the output of the target transformer layer. Then only the auxiliary classifier is trained for well-known NLP tasks like part-of-speech (POS) Tagging, Named-entity recognition (NER) Tagging, Syntactic Dependency, etc. Tenney et al. (2019) and Liu et al. (2019) show transformer models have excellent performance in those probing tasks. These results indicate that transformer models have learned the language representation related to the probing tasks. Though the probing tasks are great tools for interpreting language models, their limitation is explained in Rogers et al. (2020). We summarize the limitation into three major points:

• Most probing tasks, like POS and NER tagging, are too simple. A model that performs well in those probing tasks does not reflect the model’s true capacity.

• Probing tasks can only verify whether a certain prior structure is learned in a language model. They can not reveal the structures beyond our prior knowledge.

• It’s hard to locate where exactly the related linguistic representation is learned in the transformer.

Efforts are made to remove those limitations and make probing tasks more diverse. For instance, Hewitt and Manning (2019) proposes “structural probe”, which is a much more intricate probing task. Jiang et al. (2020) proposes to generate specific probing tasks automatically. Non-probing methods are also explored to relieve the last two limitations. For example, Reif et al. (2019) visualizes embedding from BERT using UMAP and shows that the embeddings of the same word under different contexts are separated into different clusters. Ethayarajh (2019) analyzes the similarity between embeddings of the same word in different contexts. Both of these works show transformers provide a context-specific representation.

Faruqui et al. (2015); Arora et al. (2018); Zhang et al. (2019) demonstrate how to use dictionary learning to explain, improve, and visualize the uncontextualized word embedding representations. In
this work, we propose to use dictionary learning to alleviate the limitations of the other transformer interpretation techniques. Our results show that dictionary learning provides a powerful visualization tool, leading to some surprising new knowledge.

2 Method

Hypothesis: contextualized word embedding as a sparse linear superposition of transformer factors. It is shown that word embedding vectors can be factorized into a sparse linear combination of word factors (Arora et al., 2018; Zhang et al., 2019), which correspond to elementary semantic meanings. An example is:

apple \approx 0.09 \text{“dessert”} + 0.11 \text{“organism”} + 0.16 \text{“fruit”} + 0.22 \text{“mobile&IT”} + 0.42 \text{“other”}.

We view the latent representation of words in a transformer as contextualized word embedding. Similarly, we hypothesize that a contextualized word embedding vector can also be factorized as a sparse linear superposition of a set of elementary elements, which we call \textit{transformer factors}. The exact definition will be presented later in this section.

To learn a dictionary of transformer factors with non-negative sparse coding.

Given a set of tokenized text sequences, we collect the contextualized embedding of every word using a transformer model. We define the set of all word embedding vectors from \( l \)th layer of transformer model as \( X^{(l)} \). Furthermore, we collect the embeddings across all layers into a single set \( X = X^{(1)} \cup X^{(2)} \cup \ldots \cup X^{(L)} \).

By our hypothesis, we assume each embedding vector \( x \in X \) is a sparse linear superposition of transformer factors:

\[ x = \Phi \alpha + \epsilon, \quad s.t. \alpha \succeq 0, \tag{1} \]

where \( \Phi \in \mathbb{R}^{d \times m} \) is a dictionary matrix with columns \( \Phi_{:,c} \), \( \alpha \in \mathbb{R}^{m} \) is a sparse vector of coefficients to be inferred and \( \epsilon \) is a vector containing independent Gaussian noise samples, which are assumed to be small relative to \( x \). Typically \( m > d \) so that the representation is overcomplete. This inverse problem can be efficiently solved by FISTA algorithm (Beck and Teboulle, 2009). The dictionary matrix \( \Phi \) can be learned in an iterative fashion by using non-negative sparse coding, which we leave to the appendix section C. Each column \( \Phi_{:,c} \) of \( \Phi \) is a \textit{transformer factor} and its corresponding sparse coefficient \( \alpha_c \) is its activation level.

Visualization by top activation and \textit{LIME} interpretation. An important empirical method to visualize a feature in deep learning is to use the input samples, which trigger the top activation of the feature (Zeiler and Fergus, 2014). We adopt this convention. As a starting point, we try to visualize each of the dimensions of a particular layer, \( X^{(l)} \). Unfortunately, the hidden dimensions of transformers are not semantically meaningful, which is similar to the uncontextualized word embeddings (Zhang et al., 2019).

Instead, we can try to visualize the transformer factors. For a transformer factor \( \Phi_{:,c} \) and for a layer-\( l \), we denote the 1000 contextualized word vectors with the largest sparse coefficients \( \alpha_c^{(l)} \) as \( X_c^{(l)} \subset X^{(l)} \), which correspond to 1000 different sequences. For example, Figure 3 shows the top 5 words that activated transformer factor-17 \( \Phi_{:,17} \) at layer-0, layer-2, and layer-6 respectively. Since a contextualized word vector is generally affected by many tokens in the sequence, we can use \textit{LIME} (Ribeiro et al., 2016) to assign a weight to each token in the sequence to identify their relative
importance to $\alpha_c$. The detailed method is left to Section 3.

To determine low-, mid-, and high-level transformer factors with importance score. As we build a single dictionary for all of the transformer layers, the semantic meaning of the transformer factors has different levels. While some of the factors appear in lower layers and continue to be used in the later stages, the rest of the factors may only be activated in the higher layers of the transformer network. A central question in representation learning is: “where does the network learn certain information?” To answer this question, we can compute an “importance score” for each transformer factor $\Phi_{c,l}$ at layer-$l$ as $I_c^{(l)}$. $I_c^{(l)}$ is the average of the largest 1000 sparse coefficients $\alpha_c^{(l)}$’s, which correspond to $X_c^{(l)}$. We plot the importance scores for each transformer factor as a curve is shown in Figure 2. We then use these importance score (IS) curves to identify which layer a transformer factor emerges. Figure 2a shows an IS curve peak in the earlier layer. The corresponding transformer factor emerges in the earlier stage, which may capture lower-level semantic meanings. In contrast, Figure 2b shows a peak in the higher layers, which indicates the transformer factor emerges much later and may correspond to mid- or high-level semantic structures. More subtleties are involved when distinguishing between mid-level and high-level factors, which will be discussed later.

An important characteristic is that the IS curve for each transformer factor is relatively smooth. This indicates if a vital feature is learned in the beginning layers, it won’t disappear in later stages. Instead, it will be carried all the way to the end with gradually decayed weight since many more features would join along the way. Similarly, abstract information learned in higher layers is slowly developed from the early layers. Figure 3 and 5 confirm this idea, which will be explained in the next section.

3 Experiments and Discoveries

We use a 12-layer pre-trained BERT model (Pre; Devlin et al., 2018) and freeze the weights. Since we learn a single dictionary of transformer factors for all of the layers in the transformer, we show that these transformer factors correspond to different levels of semantic or syntactic patterns. The patterns can be roughly divided into three categories: word-level disambiguation, sentence-level pattern formation, and long-range dependency. In the following, we provide detailed visualization for each pattern category. Due to the space limit, only a small amount of the factors are demonstrated in the paper. To alleviate the “cherry-picking” bias, we also build a website for the interested readers to play with these results.

Low-level: word-level polysemy disambiguation. While the input embedding of a token contains polysemy, we find transformer factors with early IS curve peaks usually correspond to a specific word-level meaning. By visualizing the top activation sequences, we can see how word-level disambiguation is gradually developed in a transformer.

We show how the disambiguation effect develops progressively through each layer in Figure 3. In Figure 3, the top 5 activated words and their contexts for transformer factor $\Phi_{c,0}$ in different layers are listed. The top activated words in layer 0 contain the word “left” varying senses, which is being mostly disambiguated in layer 2 albeit not completely. In layer 4, the word “left” is fully disambiguated since the top-activated word contains only “left” with the word sense “leaving, exiting.” We also show more examples of those types of transformer factors in Table 1: for each transformer factor, we list out the top 3 activated words and their contexts in layer 4. As shown in the table, nearly all top-activated words are disambiguated into a single sense.

Further, we can quantify the quality of the disambiguation ability of the transformer model. In the example above, since the top 1000 activated words
Figure 3: Visualization of a low-level transformer factor, $\Phi_{:.30}$ at different layers. (a), (b) and (c) are the top-activated words and contexts for $\Phi_{:.30}$ in layer-0, 2 and 4 respectively. We can see that at layer-0, this transformer factor corresponds to word vectors that encode the word “left” with different senses. In layer-2, a majority of the top activated words “left” correspond to a single sense, “leaving, exiting.” In layer 4, all of the top-activated words “left” have corresponded to the same sense, “leaving, exiting.” Due to space limitations, we invite the readers to use our website to see more of those disambiguation effects.

| Top 3 activated words and their contexts | Explanation |
|----------------------------------------|-------------|
| **$\Phi_{:.2}$** | • that snare shot sounded like somebody’ d kicked open the door to your mind”.  
• i became very frustrated with that and finally made up my mind to start getting back into things.”  
• when evita asked for more time so she could make up her mind, the crowd demanded,” ¡ ahora, evita,< |
|  | • Word “mind”  
• Noun  
• Definition: the element of a person that enables them to be aware of the world and their experiences. |
| **$\Phi_{:.16}$** | •ington joined the five members xero and the band was renamed to linkin park.  
• times about his feelings about gordon, and the price family even sat away from park’ s supporters during the trial itself.  
• on 25 january 2010, the morning of park’ s 66th birthday, he was found hanged and unconscious in his |
|  | • Word “park”  
• Noun  
• Definition: a common first and last name |
| **$\Phi_{:.30}$** | • saying that he has left the outsiders, kovu asks simba to let him join his pride  
• eventually, all boycott’ s employees left, forcing him to run the estate without help.  
• the story concerned the attempts of a scientist to photograph the soul as it left the body. |
|  | • Word “left”  
• Verb  
• Definition: leaving, exiting |
| **$\Phi_{:.33}$** | • forced to visit the sarajevo television station at night and to him with as little light as possible to avoid the attention of snipers and bombers.  
• by the modest, cream®-® colored attire in the airy, light®-® filled clip.  
• the man asked her to help him carry the case to his car, a light®-® brown volkswagen beetle. |
|  | • Word “light”  
• Noun  
• Definition: the natural agent that stimulates sight and makes things visible |

Table 1: Several examples of low-level transformer factors. Their top-activated words in layer 4 are marked blue, and the corresponding contexts are shown as examples for each transformer factor. As shown in the table, nearly all of the top-activated words are disambiguated into a single sense. Please note the last example of $\Phi_{:.33}$ is a rare exception, the reader may check the appendix to see a more complete list. More examples, top-activated words and contexts are provided in Appendix.

and contexts are “left” with only the word sense “leave, exiting”, we can assume “left” when used as a verb, triggers higher activation in $\Phi_{:.30}$ than “left” used as other sense of speech. We can verify this hypothesis using a human-annotated corpus: Brown corpus (Francis and Kucera, 1979). In this corpus, each word is annotated with its corresponding part-of-speech. We collect all the sentences contains the word “left” annotated as a verb in one set and sentences contains “left” annotated as other part-of-speech. As shown in Figure 4a, in layer 0, the average activation of $\Phi_{:.30}$ for the word “left” marked as a verb is no different from “left” as other senses. However, at layer 2, “left” marked as a verb triggers a higher activation of $\Phi_{:.30}$. In layer 4, this difference further increases, indicating disambiguation develops progressively across layers. In fact, we plot the activation of “left” marked as verb and the activation of other “left” in Figure 4b. In layer 4, they are nearly linearly separable by this
Figure 4: (a) Average activation of $\Phi_{30}$ for word vector “left” across different layers. (b) Instead of averaging, we plot the activation of all “left” with different contexts in layer-0, 2, and 4. Random noise is added to the y-axis to prevent overplotting. The activation of $\Phi_{30}$ for two different word senses of “left” is blended together in layer-0. They disentangle to a great extent in layer-2 and nearly separable in layer-4 by this single dimension.

Figure 5: Visualization of a mid-level transformer factor. (a), (b), (c) are the top 5 activated words and contexts for this transformer factor in layer-4, 6, and 8 respectively. Again, the position of the word vector is marked blue. Please notice that sometimes only a part of a word is marked blue. This is due to that BERT uses word-piece tokenizer instead of whole word tokenizer. This transformer factor corresponds to the pattern of “consecutive adjective”. As shown in the figure, this feature starts to develop at layer-4 and fully develops at layer-8.

| Method                        | Precision (%) | Recall (%) | F1 score (%) |
|-------------------------------|---------------|------------|--------------|
| Average perceptron POS tagger | 92.7          | 95.5       | 94.1         |
| Finetuned BERT base model for POS task | 97.5          | 95.2       | 96.3         |
| Logistic regression classifier with activation of $\Phi_{30}$ at layer 4 | 97.2          | 95.8       | 96.5         |

Table 2: Evaluation of binary POS tagging task: predict whether or not “left” in a given context is a verb.

Single feature. Since each word “left” corresponds to an activation value, we can perform a logistic regression classification to differentiate those two types of “left”. From the result shown in Figure 4a, it is pretty fascinating to see that the disambiguation ability of just $\Phi_{30}$ is better than the other two classifiers trained with supervised data. This result confirms that disambiguation is indeed done in the early part of pre-trained transformer model and we are able to detect it via dictionary learning.

Mid level: sentence-level pattern formation. We find most of the transformer factors, with an IS curve peak after layer 6, capture mid-level or high-level semantic meanings. In particular, the mid-level ones correspond to semantic patterns like phrases and sentences pattern.

We first show two detailed examples of mid-level transformer factors. Figure 5 shows a transformer factor that detects the pattern of consecutive usage of adjectives. This pattern starts to emerge at layer 4, develops at layer 6, and becomes quite reliable at layer 8. Figure 6 shows a transformer factor, which corresponds to a pretty unexpected pattern: “unit exchange”, e.g., 56 inches (140 cm). Although this exact pattern only starts to appear at layer 8, the sub-structures that make this pattern, e.g., parenthesis and numbers, appear to trigger this factor in layers 4 and 6. Thus this transformer factor is also...
While some mid-level transformer factors verify common semantic or syntactic patterns, there are also many surprising mid-level transformer factors. We list a few in Table 3 with quantitative analysis.

Table 3: A list of typical mid-level transformer factors. The top-activation words and their context sequences for each transformer factor at layer-8 are shown in the second column. We summarize the patterns of each transformer factor in the third column. The last 4 columns are the percentage of the top 200 activated words and sequences that contain the summarized patterns in layer-4, 6, 8, and 10 respectively.

![Table 3](image)

For each listed transformer factor, we analyze the top 200 activating words and their contexts in each layer. We record the percentage of those words and contexts that correspond to the factors’ semantic pattern in Table 3. From the table, we see that large

gradually developed through several layers.

Figure 6: Another example of a mid-level transformer factor visualized at layer-4, 6, and 8. The pattern that corresponds to this transformer factor is “unit exchange”. Such a pattern is somewhat unexpected based on linguistic prior knowledge.
percentages of top-activated words and contexts do corresponds to the pattern we describe. It also shows most of these mid-level patterns start to develop at layer 4 or 6. More detailed examples are provided in the appendix section F. Though it’s still mysterious why the transformer network develops representations for these surprising patterns, we believe such a direct visualization can provide additional insights, which complements the “probing tasks”.

To further confirm a transformer factor does correspond to a specific pattern, we can use constructed example words and context to probe their activation. In Table 4, we construct several text sequences that are similar to the patterns corresponding to a particular transformer factor but with subtle differences. The result confirms that the context that strictly follows the pattern represented by that transformer factor triggers a high activation. On the other hand, the closer the adversarial example to this pattern, the higher activation it receives at this transformer factor.

### High-level: long-range dependency

High-level transformer factors correspond to those linguistic patterns that span an extended range in the text. Since the IS curves of mid-level and high-level transformer factors are similar, it is difficult to distinguish those transformer factors based on their IS curves. Thus, we have to manually examine the top-activation words and contexts for each transformer factor to differentiate between mid-level and high-level transformer factors. To ease the process, we choose to use the black-box interpretation algorithm **LIME** (Ribeiro et al., 2016) to identify the contribution of each token in a sequence. There also exist interpretation tools that specifically leverage the transformer architecture (Chefer et al., 2021, 2020). In the future, one could adapt those interpretation tools, which may potentially provide better visualization.

Given a sequence \( s \in S \), we can treat \( \alpha_{c,i}^{(l)} \), the activation of \( \Phi_{c,i} \) in layer-\( l \) at location \( i \), as a scalar function of \( s \), \( f_{c,i}^{(l)}(s) \). Assume a sequence \( s \) triggers a high activation \( \alpha_{c,i}^{(l)} \), i.e. \( f_{c,i}^{(l)}(s) \) is large. We want to know how much each token (or equivalently each position) in \( s \) contributes to \( f_{c,i}^{(l)}(s) \). To do so, we generated a sequence set \( S(s) \), where each \( s' \in S(s) \) is the same as \( s \) except for that several random positions in \( s' \) are masked by [‘UNK’] (the unknown token). Then we learn a linear model \( g_w(s') \) with weights \( w \in \mathbb{R}^T \) to approximate \( f(s') \), where \( T \) is the length of sentence \( s \). This can be solved as a ridge regression:

\[
\min_{w \in \mathbb{R}^T} \mathcal{L}(f, w, S(s)) + \sigma \|w\|_2^2.
\]

The learned weights \( w \) can serve as a saliency map that reflects the “contribution” of each token in the sequence \( s \). Like in Figure 7, the color reflects the weights \( w \) at each position. Red means the given position has positive weight and green means negative weight. The magnitude of weight is represented by the intensity. The redder a token is, the more it contributions to the activation of the transformer factor. We leave more implementation and mathematical formulation details of LIME algorithm in the appendix.

| Adversarial Text | Explanation | \( \alpha_{35} \) |
|------------------|-------------|-----------------|
| (o) album as "full of exhilarating, ecstatic, thrilling, fun and sometimes downright silly songs" | The original top-activated word and its context sentence for transformer factor \( \Phi_{c,35} \) (not an adversarial text) | 9.5 |
| (a) album as "full of delightful, lively, exciting, interesting and sometimes downright silly songs" | Replace the adjectives in sentence (o) with different adjectives. | 9.2 |
| (b) album as "full of unfortunate, heartbroken, annoying, boring and sometimes downright silly songs" | Replace the adjectives in sentence (o) with negative adjectives. | 8.2 |
| (c) album as "full of [UNK], [UNK], thrilling, [UNK] and sometimes downright silly songs" | Mask the adjectives in sentence (o) with unknown tokens. | 5.3 |
| (d) album as "full of thrilling and sometimes downright silly songs" | Remove the first three adjectives in sentence (o). | 7.8 |
| (e) album as "full of natural, smooth, rock, electronic and sometimes downright silly songs" | Replace the adjectives in sentence (o) with neutral adjectives. | 6.2 |
| (f) each participant starts the battle with one balloon. these can be re@-@ inflated up to four | Use a random sentence. | 0.0 |
| (g) The book is described as "innovative, beautiful and brilliant". It receive the highest opinion from James Wood | We create this sentence that contain the pattern of consecutive adjective. | 7.9 |

Table 4: We construct adversarial texts similar but different to the pattern “Consecutive adjective”. The last column shows the activation of \( \Phi_{c,35} \) or \( \alpha_{35}^{(8)} \) w.r.t. the blue-marked word in layer 8.
We provide detailed visualization for two different transformer factors that show long-range dependency in Figure 7, 8. Since visualization of high-level information requires more extended context, we only offer the top two activated words and their contexts for each such transformer factor. Many more will be provided in the appendix section G.

We name the pattern for transformer factor \( \Phi_{297} \) in Figure 7 as “repetitive pattern detector”. All top activated contexts for \( \Phi_{297} \) contain an obvious repetitive structure. Specifically, the text snippet “can’t get you out of my head” appears twice in the first example, and the text snippet “xxx class passenger, star alliance” appears three times in the second example. Compared to the patterns we found in the mid-level [6], the high-level patterns like “repetitive pattern detector” are much more abstract. In some sense, the transformer detects if there are two (or multiple) almost identical embedding vectors at layer-10 without caring what they are. Such behavior might be highly related to the concept proposed in the capsule networks (Sabour et al., 2017; Hinton, 2021). To further understand this behavior and study how the self-attention mechanism helps model the relationships between the features outlines an interesting future research direction.

Figure 8 shown another high-level factor, which detects text snippets related to “the beginning of a biography”. The necessary components, day of birth as month and four-digit years, first name and last name, familial relation, and career, are all mid-level information. In Figure 8, we see that all the information relates to biography has a high weight in the saliency map. Thus, they are all together combined to detect the high-level pattern.

4 Discussion

Dictionary learning has been successfully used to visualize the classical word embeddings (Arora et al., 2018; Zhang et al., 2019). In this paper, we propose to use this simple method to visualize the representation learned in transformer networks to supplement the implicit “probing-tasks” methods. Our results show that the learned transformer factors are relatively reliable and can even provide many surprising insights into the linguistic structures. This simple tool can open up the transformer networks and show the hierarchical semantic or syntactic representation learned at different stages. In short, we find word-level disambiguation, sentence-level pattern formation, and long-range dependency. The idea of a neural network learns low-level features in early layers, and abstract concepts in the later stages are very similar to the visualization in CNN (Zeiler and Fergus, 2014). Dictionary learning can be a convenient tool to help visualize a broad category of neural networks with skip connections, like ResNet (He et al., 2016), ViT models (Dosovitskiy et al., 2020), etc. For more interested readers, we provide an interactive website\(^1\) for the readers to gain some further insights.

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\(^1\)https://transformervis.github.io/transformervis/
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Supplementary Materials

A Importance Score (IS) Curves

![IS Curves](image)

Figure 9: (a) Importance score of 16 transformer factors corresponding to low level information. (b) Importance score of 16 transformer factors corresponds to mid level information respectively.

The importance score curve’s characteristic has a strong correspondence to a transformer factor’s categorization. Based on the location of the peak of an IS curve, we can classify a transformer factor as low-level, mid-level or high-level. The importance score for low-level transformer factors peak in early layers and slowly decrease across the rest of the layers. On the other hand, the importance score for mid-level and high-level transformers slowly increases and peaks at higher layers. In Figure 9, we show two sets of the examples to demonstrate the clear distinction between those two types of IS curves.

Taking a step back, we can also plot IS curve for each dimension of word vector (without sparse coding) at different layers. They do not show any specific patterns, as shown in Figure 10. This makes intuitive sense since we mentioned that each of the entries of a contextualized word embedding does not correspond to any clear semantic meaning.

![IS Curves without sparse coding](image)

Figure 10: (a) Importance score calculated using certain dimension of word vectors without sparse coding. (b) Importance score calculated using sparse coding of word vectors.

B LIME: Local Interpretable Model-Agnostic Explanations

After we trained the dictionary $\Phi$ through non-negative sparse coding, the inference of the sparse code of a given input is

$$\alpha(x) = \arg \min_{\alpha \in \mathbb{R}} ||x - \Phi \alpha||_2^2 + \lambda ||\alpha||_1$$

For a given sentence and index pair $(s, i)$, the embedding of word $w = s[i]$ by layer $l$ of transformer is $x(l)(x, i)$. Then we can abstract the inference of a specific entry of sparse code of the word vector as a black-box scalar-value function $f$:

$$f((s, i)) = \alpha(x(l)(s, i))$$

Let $RandomMask$ denotes the operation that generates perturbed version of our sentence $s$ by masking word at random location with “[UNK]” (unknown) tokens. For example, a masked sentence could be

[Today is a [UNK],day]

Let $h$ denote a encoder for perturbed sentences compared to the unperturbed sentence $s$, such that

$$h(s)_t = \begin{cases} 
0 & \text{if } s[t] = [\text{UNK}] \\
1 & \text{Otherwise}
\end{cases}$$

The LIME algorithm we used to generated saliency map for each sentences is the following:

**Algorithm 1 Explaining Sparse Coding Activation using LIME Algorithm**

1: $S = \{h(s)\}$  
2: $Y = \{f(s)\}$  
3: for each $i \in \{1, 2, \ldots, N\}$ do  
4: $s'_i \leftarrow RandomMask(s)$  
5: $S \leftarrow S \cup h(s'_i)$  
6: $Y \leftarrow Y \cup f(s'_i)$  
7: end for  
8: $w \leftarrow \text{Ridge}_w(S, Y)$

Where $\text{Ridge}_w$ is a weighted ridge regression defined as:

$$w = \arg \min_{w \in \mathbb{R}^n} ||\Sigma \omega w - Y||^2 + \lambda ||w||^2$$

$$\Sigma = \text{diag}(d(h(S_1), \bar{1}), d(h(S_2), \bar{1}), \ldots, d(h(S_n), \bar{1}))$$

$d(\cdot, \cdot)$ can be any metric that measures how much a perturbed sentence is different from the original sentence. If a sentence is perturbed such that every token is being masked, then the distance $h(h(s'), \bar{1})$...
should be 0, if a sentence is not perturbed at all, then \( h(h(s'), \bar{1}) \) should be 1. We choose \( d(\cdot, \cdot) \) to be cosine similarity in our implementation.

In practice, we also use feature selection. This is done by running LIME twice. After we obtain the regression weight \( w_1 \) for the time, we use it to find the first \( k \) indices corresponds to the entry in \( w_1 \) with highest absolute value. We use those \( k \) index as location in the sentence and apply LIME for the second time with only those selected indices from step 1.

Overall, the regression weight \( w \) can be regarded as a saliency map. The higher the weight \( w_k \) is, the more important the word \( s[k] \) in the sentence since it contributes more to the activation of a specific transformer factor.

We could also have negative weight in \( w \). In general, negative weights are hard to interpret in the context of transformer factor. The activation will increase if they are removed those word correspond to negative weights. Since a transformer factor corresponds to a specific pattern, then word with negative weights are those word in a context that behaves “opposite” of this pattern.

**C The Details of the Non-negative Sparse Coding Optimization**

Let \( S \) be the set of all sequences, recall how we defined word embedding using hidden state of transformer in the main section: \( X^{(l)} = \{x^{(l)}(s, i) | s \in S, i \in [0, len(s)]\} \) as the set of all word embedding at layer \( l \), then the set of word embedding across all layers is defined as

\[
X = X^{(1)} \cup X^{(2)} \cup \cdots \cup X^{(L)}
\]

In practice, we use BERT base model as our transformer model, each word embedding vector (hidden state of BERT) is dimension 768. To learn the transformer factors, we concatenate all word vector \( x \in X \) into a data matrix \( A \). We also defined \( f(x) \) to be the frequency of the token that is embedded in word vector \( x \). For example, if \( x \) is the embedding of the word “the”, it will have a much larger frequency i.e. \( f(x) \) is high.

Using \( f(x) \), we define the Inverse Frequency Matrix \( \Omega \): \( \Omega \) is a diagonal matrix where each entry on the diagonal is the square inverse frequency of each word, i.e.

\[
\Omega = \text{diag}(\frac{1}{\sqrt{f(x_1)}}, \frac{1}{\sqrt{f(x_2)}}, ...)
\]

Then we use a typical iterative optimization procedure to learn the dictionary \( \Phi \) described in the main section:

\[
\min_A \frac{1}{2} \|X - \Phi A\|_F^2 + \lambda \sum_i \|\alpha_i\|_1, \text{ s.t. } \alpha_i \geq 0, \tag{2}
\]

\[
\min_{\Phi} \frac{1}{2} \|X - \Phi \Omega A\|_F^2, \: \|\Phi_{:,j}\|_2 \leq 1. \tag{3}
\]

These two optimizations are both convex, we solve them iteratively to learn the transformer factors: In practice, we use minibatches contains 200 word vectors as \( X \). The motivation of apply Inverse Frequency Matrix \( \Omega \) is that we want to make sure all words in our vocabulary has the same contribution. When we sample our minibatch from \( A \), frequent words like “the” and “a” are much likely to appear, which should receive lower weight during update.

Optimization 2 can converge in 1000 steps using the FISTA algorithm\(^2\). We experimented with different \( \lambda \) values from 0.03 to 3, and choose \( \lambda = 0.27 \) to give results presented in this paper. Once the sparse coefficients have been inferred, we update our dictionary \( \Phi \) based on Optimization 3 by one step using an approximate second-order method, where the Hessian is approximated by its diagonal to achieve an efficient inverse (Duchi et al., 2011). The second-order parameter update method usually leads to much faster convergence. Empirically, we train 200k steps and it takes roughly 2 days on a Nvidia 1080 Ti GPU.

**D Hyperlinks for More Transformer Visualization**

In the following three sections, we provide visualization of more example transformer factor in low-level, mid-level, and high-level. Here’s table of Contents that contain hyperlinks which direct to each level:

- Low-Level: E
- Mid-Level: F
- High-Level: G

\(^2\)The FISTA algorithm can usually converge within 300 steps, we use 1000 steps nevertheless to avoid any potential numerical issue.
E Low-Level Transformer Factors

Transformer factor 2 in layer 4
Explanation: Mind: noun, the element of a person that enables them to be aware of the world and their experiences.

- that snare shot sounded like somebody’d kicked open the door to your mind”.
- i became very frustrated with that and finally made up my mind to start getting back into things.”
- when evita asked for more time so she could make up her mind, the crowd demanded,” ¡ ahora, evita,”
- song and watch it evolve in front of us... almost as a memory in your head.
- was to be objective and to let the viewer make up his or her own mind.”
- managed to give me goosebumps, and those moments have remained on my mind for weeks afterward.”
- rests the tire’d mind, and waking loves to dream
- tracks like’ halftime’ and the laid back’ one time 4 your mind’ demonstrated [a high] level of technical precision and rhetorical dexterity
- so i went to bed with that on my mind”.
- ment to a seed of doubt that had been playing on mulder’ s mind for the entire season”.
- my poor friend smart shewed the disturbance of his mind, by falling upon his knees, and saying his prayers in the street
- donoghue complained that lessing has not made up her mind on whether her characters are” the salt of the earth or its sc
- release of the new lanois@-@ produced album, time out of mind.
- sympathetic man to illegally” ghost@-@ hack” his wife’ s mind to find his daughter.
- this album veered into” the corridors” of flying lotus’” own mind”, interpreting his guest vocalists as” disembodied phantom

Transformer factor 16 in layer 4
Explanation: Park: noun, ‘park’ as the name

- allmusic writer william ruhlmann said that” linkin park sounds like a johnny@-@ come@-@ lately to an
- nington joined the five members xero and the band was renamed to linkin park.
- times about his feelings about gordon, and the price family even sat away from park’ s supporters during the trial itself.
- on 25 january 2010, the morning of park’ s 66th birthday, he was found hanged and unconscious in his
- was her, and knew who had done it”, expressing his conviction of park’ s guilt.
- jeremy park wrote to the north@-@ west evening mail to confirm that he
- vanessa fisher, park’ s adoptive daughter, appeared as a witness for the prosecution at the
- they played at< unk> for years before joining oldham athletic at boundary park until 2010 when they moved to oldham borough’ s previous ground,<
- theme park guests may use the hogwarts express to travel between hogwarts
- s strength in both singing and rapping while comparing the sound to linkin park.
- in a statement shortly after park’ s guilty verdict, he said he had” no doubt” that
- june 2013, which saw the band travel to rock am ring and rock im park as headline act, the song was moved to the middle of the set
- after spending the first decade of her life at the central park zoo, pattycake moved permanently to the bronx zoo in 1982.
- south park spoofed the show and its hosts in the episode” south park is gay!”
- harrison” sounds like he’ s recorded his vocal track in one of the park’ s legendary caves”.

Transformer factor 30 in layer 4
Explanation: left: verb, leaving, exiting

- did succeed in getting the naval officers into his house, and the mob eventually left.
- all of the federal troops had left at this point, except rotten who had stayed behind to listen to
- saying that he has left the outsiders, kovu asks simba to let him join his pride
- eventually, all boycott’ s employees left, forcing him to run the estate without help.
- the story concerned the attempts of a scientist to photograph the soul as it left the body.
- in time and will slowly improve until he returns to the point at which he left.
- peggy’ s exit was a” non event”, as” peggy just left, nonsensically and at complete odds with everything we’ ve
over the course of the group’s existence, several hundred people joined and left.
no profit was made in six years, and the church left, losing their investment.
on 7 november he left, missing the bolshevik revolution, which began on that day.
he had not re- written his will and when produced still left everything to his son lunalilo.
they continued filming as normal, and when Lynch yelled cut, the townspeople had left.
with land of black gold (1950), a story that he had previously left unfinished, instead.
he was infuriated that the government had left thousands unemployed by closing down casinos and brothels.
an impending marriage between her and albert interfered with their studies, the two brothers left on 28 august 1837 at the close of the term to travel around europe

Transformer factor 33 in layer 4
Explanation: light: noun, the natural agent that stimulates sight and makes things visible:
forced to visit the sarajevo television station at night and to film with as little light as possible to avoid the attention of snipers and bombers.
by the modest, cream-colored attire in the airy, light filled clip.
the man asked her to help him carry the case to his car, a light brown volkswagen beetle.
they are portrayed in a particularly sympathetic light when they are killed during the ending.
caught up” was directed by mr. x, who was behind the laser light treatment of usher’s 2004 video” yeah!”
piracy in the indian ocean, and the script depicted the pirates in a sympathetic light.
without the benefit of moon light, the light horsemen had fired at the flashes of the enemy’s second innings, voce repeated the tactic late in the day, in fading light against woodfull and bill brown.
and the workers were transferred on 7 july to another facility belonging to early light, 30 km away in (unk) town.
(unk) brooklyn avenue ne near the university of washington campus in a small light industrial building leased from the university.

Transformer factor 47 in layer 4
Explanation: plants: noun, vegetation
the distinct feature of the main campus is the mall, which is a large tree laden grassy area where many students go to relax.
each school in the london borough of hillingdon was invited to plant a tree, and the station commander of raf northolt, group captain tim o
its diet in summer contains a high proportion of insects, while more plant items are eaten in autumn.
large fruitings of the fungus are often associated with damage to the host tree, such as that which occurs with burning.
she nests on the ground under the cover of plants or in cavities such as hollow tree trunks.
orchards, heaths and hedgerows, especially where there are some old trees.
the scent of plants such as yarrow acts as an olfactory attractant to females.
of its grasshopper host, causing it to climb to the top of a plant and cling to the stem as it dies.
well-drained or sandy soil, often in the partial shade of trees.
food is taken from the ground, low growing plants and from inside grass tussocks; the crake may search leaf
into his thought that the power of gravity( which brought an apple from a tree to the ground) was not limited to a certain distance from earth.
they eat both seeds and green plant parts and consume a variety of animals, including insects, crustaceans
fyne, argyll in the 1870s was named as the uk’s
tallest tree in 2011.
• *, or colourless enamel, as in the ground areas, rocks and trees.
• produced from 16 to 139 weeks after a forest fire in areas with coniferous trees.

This is the end of visualization of low-level transformer factor. Click [D] to go back.
F Mid-Level Transformer Factors

Transformer factor 13 in layer 10
Explanation: Unit exchange with parentheses: e.g. 10 m (1000cm)

- 14@-@ 16 hand (56 to 64 inches (140 to 160 cm)) war horse is that it was a matter of pride to a
- behind many successful developments, defaulted on the $214 million ($47 billion) in bonds held by 60@, @ 000 investors; the van
- straus, behind many successful developments, defaulted on the $214 million ($47 billion) in bonds held by 60@, @ 000 investors;
- the niche is 4 m (13 ft) wide and 3@.
- with a top speed of nearly 21 knots (39 km/h; 24 mph).
- @ 4 billion (us$ 21 million) — india’s highest@-@ earning film of the year
- @ at deep load as built, with a length of 310 ft (94 m), a beam of 73 feet 7 inches (22@.
- @ 3@-@ inch (160 mm) calibre steel barrel.
- and gave a maximum speed of 23 knots (43 km/h; 26 mph).
- • 2 km) in length, with a depth around 790 yards (720 m), and in places only a few yards separated the two sides.
- • hull provided a combined thickness of between 24 and 28 inches (60 – 70 cm), increasing to around 48 inches (1@.
- • switzerland, austria and germany; and his mother, lynette federer (born durand), from kempton park, gauteng, is
- • @ 2 in (361 mm) thick sides.
- • and a top speed of 30 knots (56 km/h; 35 mph).
- • an outdoor seating area (4@, @ 300 square feet (400 m2)) and a 2@, @ 500@-@ square@

Transformer factor 24 in layer 10
Explanation: Male name

- divorcing doqui in 1978, michelle married robert h. tucker, jr. the following year, changed her name to gee tucker, moved back
- divorced doqui in 1978 and married new orleans politician robert h. tucker, jr. the following year; she changed her name to gee tucker and became
- including isabel sanford, when chuck and new orleans politician robert h. tucker, jr. visited michelle at her hotel.
- of 32 basidiomycete mushrooms showed that mutinus elegans was the only species to show antibiotic (both antibacterial
- amphicoelias, it is probably synonymous with camarasauros grandis rather than c. supremus because it was found lower in the
- • [ her] for warmth and virtue” and mehul s. thakkar of the deccan chronicle wrote that she was successful in” deliver[em( queen latifah) and uncle henry( david alan grier) own a diner, to which dorothy works for room and board.
- • in melbourne on 10 august 1895, presented by dion boucicault, jr. and robert brough, and the play was an immediate success.
- • in the early 1980s, james r. tindall, sr. purchased the building, the construction of which his father had originally financed
- • in 1937, when chakravarthi rajagopalachari became the chief minister of madras presidency, he introduced hindi as a compulsory
- • in 1905 william lewis moody, jr. and isaac h. kempner, members of two of galveston’
- • also, walter b. jones, jr. of north carolina sent a letter to the republican conference chairwoman cathy
- • empire’ s leading generals, nikephoros bryennios the elder, the doux of dyrrhachium in the western balkans
- • in bengali as< unk>: the warrior by raj chakraborty with dev and mimi chakraborty portraying the lead roles.
- • on 1 june 1989, erik g. braathen, son of bjørn g., took over as ceo

Transformer factor 25 in layer 10
Explanation: Attributive Clauses

- which allows japan to mount an assault on the us; or kill him, which lets the us discover japan’
- s role in rigging american elections —
- certain stages of development, and constitutive heterochromatin that consists of chromosome structural components such as telomeres and centromeres
- to the mouth of the nueces river, and oso bay, which extends south to the mouth of oso creek.
- @, @ 082 metric tons, and argentina, which ranks 17th, with 326, @, @ 900 metric tons.
- of$ 42@, @ 693 and females had a median
income of $34,795.
• ultimately scored 14 points with 70 per cent shooting, and crispin, who scored twelve points with 67 per cent shooting.
• and is operated by danish air transport, and one jetstream 32, which seats 19 and is operated by helitrans.
• acute stage, which occurs shortly after an initial infection, and a chronic stage that develops over many years.
• earl of warwick and then william of lancaster, and ada de warenne who married henry, earl of huntingdon.
• who ultimately scored 14 points with 70 per cent shooting, and crispin, who scored twelve points with 67 per cent shooting.
• in america, while halo/ walking on sunshine charted at number 4 in ireland, 9 in the uk, 10 in australia, 28 in canada
• five events, heptathlon consisting of seven events, and decathlon consisting of ten every multi event, athletes participate in a
• @ life of 154,000 years, and 235np with a half life of 396.
• comfortable, and intended to function as the prison, and the second floor was better finished, with a hall and a chamber, and probably operated as the
• b, which serves the quonset freeway, and exit 7a, which serves route 402( frenchtown road), another spur route connecting the

Transformer factor 42 in layer 10
Explanation: Some kind of disaster, something unfortunate happened

• after the first five games, all losses, jeff carter suffered a broken foot that kept him out of the line up for
• allingham died of natural causes in his sleep at 3:10 am on 18 july 2009 at his
• upon reaching corfu, thousands of serb troops began showing symptoms of typhus and had to be quarantined on the island of un
• than a year after the senate general election, the september 11, 2001 terrorist attacks took place, with giuliani still mayor.
• the starting job because fourth year junior grady was under suspension related to driving while intoxicated charges.
• his majesty, but as soon as they were on board ship, they died of melancholy, having refused to eat or drink.
• on 16 september 1918, before she had even gone into action, she suffered a large fire in one of her 6 inch magazines, and
• orange goalkeeper for long time starter john galloway who was sick with the flu.
• in 1666 his andover home was destroyed by fire, supposedly because of the carelessness of the maid”.
• the government, on 8 february, admitted that the outbreak may have been caused by semi processed turkey meat imported directly
• ikromo came under investigation by the justice office of the dutch east indies for publishing several further anti dutch editorials.
• that he could attend to the duties of his office, but fell ill with a fever in august 1823 and died in office on september 1.
• $2 billion initiative to combat cholera and the construction of a$17 million teaching hospital in

Transformer factor 50 in layer 10
Explanation: Doing something again, or making something new again

• 2007 saw the show undergo a revamp, which included a switch to recording in hdtv, the introduction
• during the ship’s 1930 reconstruction; the maximum elevation of the main guns was increased to 43 degrees, increasing their maximum range from 25.
• hurricane pack 1 was a revamped version of story mode; team ninja tweaked the
• she was fitted with new engines and more powerful water tube boilers rated at 6@
• from 1988 to 2000, the two western towers were substantially overhauled with a viewing platform provided at the top of the north tower.
• latest missoula downtown master plan in 2009, increased emphasis was directed toward
redeveloping the north side’s former rail yard and the area
• 1896: the ribbon of the army version medal of honor was redesigned with all stripes being vertical.
• the new badge includes a star to represent the european cup win in 1982, and
• missoula downtown master plan in 2009, increased emphasis was directed toward redeveloping the north side’s former rail yard and the area just
• also assisted in comprehensive infrastructure renovations, restored a dependable supply of electricity, revamped the baggage handling facilities as well as the arrival and departure lounge
• hurricane pack 1 was a revamped version of story mode; team ninja tweaked the encounters
• 1896: the ribbon of the army version medal of honor was redesigned with all stripes being vertical.
• from 1988 to 2000, the two western towers were substantially overhauled with a viewing platform provided at the top of the north tower
• assisted in comprehensive infrastructure renovations, restored a dependable supply of electricity, revamped the baggage handling facilities as well as the arrival and departure lounges
• bond series and the fourth to star roger moore as bond; the plot was significantly changed from the novel to include excursions into space.

Transformer factor 51 in layer 10
Explanation: apostrophe s, possessive

• the irish times was critical of the book’s text but wrote positively of the included photographs.
• if it survived long enough to become old-fashioned it was likely to be
• you by phil spector as his inspirations, which resulted to the album’s wall of sound resonance.
• the irish times was critical of the book’s text but wrote positively of the included photographs.
• album to the wu tang clan and nine inch nails, particularly comparing the album’s production( which was done by various producers with executive producer don gilmore
• to the wu tang clan and nine inch nails, particularly comparing the album’s production( which was done by various producers with executive producer don gilmore)
• toward the commoners and interested in easing their burden but suspicious about the letter’s true purpose, reluctantly signed the document under intense pressure from the french
• the novel’s reception was even warmer than that of its predecessor; waugh was
• first song selected for inclusion after her mother’s recommendation and the song’s melancholic lyrics.
• it divided critics at the time; although they praised the game’s writing and scale of choice, they criticized its technical flaws.
• mgm executive al lewin said that several years after the film’s release stroheim asked him for the cut footage.
• the game’s production was turbulent, as the design’s scope exceeded the available resources
• nicki escudero from the phoenix new times noted the song’s superficial themes which included lyrics about “sex, money and cheating”
• mgm executive al lewin said that several years after the film’s release stroheim asked him for the cut footage.
• labrie said that there was “a lot of discussion” about the song’s wording and how direct it should be.

Transformer factor 86 in layer 10
Explanation: Pattern: Consecutive years, this is convention to name football/rugby game season

• with york the previous season, signed a contract until the end of 2013–14 and sheffield united midfielder elliott whitehouse signed on a onearker
• as of the end of the 2014–15 season, aston villa have spent 104 seasons in the top tier of english
• won 13 and drew two of their opening 15 league matches of the 1985–86 campaign, and seemed destined to win the first division title.
• mcallister, still without a goal in 2009–10, couldn’t get on the scoresheet in the three games
• john bentley led united to a fourth place finish in 1912–13.
• he made 46 appearances, scoring three goals, in the 2001–02 season before spending the close season with the kalamazoo kingdom in the
• he moved to basingstoke town towards the end of 2001–02, making his debut in march 2002.
• 7[ note 1] was the worst record in the NHL for 2011 – 12 and the first time in franchise history they finished in last place.
• side, who withdrew from the football league at the end of the 1893 – 94 season after finishing bottom of the second division.
• spent a year as a physics instructor at the university of minnesota in 1916 – 17, then two years as a research engineer with the westinghouse lamp.
• defeat was a 7 – 2 loss to witton albion in the 2001 – 02 season.
• york achieved three successive wins for the first time in 2013 – 14 after beating northampton 2 – 0 away, with bowman and fletcher scoring in.
• he started to develop more of an offensive game, finishing off the 2001 – 02 season with 58 points in the 47 games he played in seattle.

Transformer factor 99 in layer 10
Explanation: past tense

• r. in their review of rihanna’ s top 20 songs, time out ranked" man down" as their tenth best track, writing that it is
• rolling stone ranked" imagine" number three on its list of" the 500 greatest songs
• japan’ s computer entertainment rating organization( cero) rated ninja gaiden and black, on their release, as 18+
• ultimate classic rock ranked" lola” as the kinks’
• adrien begrand of popmatters described” south of heaven” as an unorthodox set opener
• columbia records released it as the album’ s fourth and final single on june 14,
• rolling stone ranked it the best song of 2009 and the 36th@-@ best song
• indielondon’ s jack foley noted" wind it up" as a highlight of the sweet escape and called
• premiere magazine listed frank booth, played by dennis hopper, as the fifty@-@
• columbia records released" crazy in love" on may 18, 2003, as the lead
• the times considered the production the best since the original, and praised it for its fidelity
• the good food guide ranked hibiscus as the eighth@-@ best restaurant in the uk
• viz media later began releasing the manga as simply” ral grad" in february 2008.
• entertainment weekly magazine ranked" crazy in love" forty@-@ seven in its list of
• the japanese publisher nihon bungeisha released the series in collected volumes from january 2000 to september 2009.

Transformer factor 102 in layer 10
Explanation: African name

• s 1966 to 1971 live performances in paris, prepared to press the album once mwanga provided the label with the record< unk>.
• of america” with the nhk symphony orchestra, but cancelled both deals upon mwanga’ s return from japan.
• 1966 to 1971 live performances in paris, prepared to press the album once mwanga provided the label with the record< unk>.
• and langston Hughes, and by modern african poets and folk artists such as kwesi brew and efua sutherland, which also influenced her auto
• america” with the nhk symphony orchestra, but cancelled both deals upon mwanga’ s return from japan.
• du bois was buried in accra near his home, which is now the du bois memorial centre.
• du bois returned to africa in late 1960 to attend the inauguration of nnamdi azikiwe as the first african governor of nigeria.
• david mcgurk, lanre oyebanjo, danny parslow, tom platt and chris smith signed new
• and moderate nationalist parties, the most prominent of which was bishop abel muzorewa’ s united african national council( uanc).
• a few weeks after of human feelings was recorded, mwanga went to japan to negotiate a deal with trio records to have the
• and was part of two large campaigns, one to witu and another to mwele.
• returned to africa in late 1960 to attend the inauguration of nnamdi azikiwe as the first african governor of nigeria.
• in april, mwanga arranged another session at cbs studios in new york city, and coleman
• the government and moderate nationalist parties, the most prominent of which was bishop abel
muzorewa’s United African National Council (UANC).

- Ralambo’s father, Andriananelo, had established rules of succession by which Ralambo’s.

Transformer factor 125 in layer 10
Explanation: Describing someone in a paraphrasing style. Name, Career

- Journalist Tim Judah suggests that the move may have been motivated by a desire to control a
- The historian Nora Berend says that the latter measure” may have adversely affected
- From the pyx that were not assayed, and numismatic historian Roger Burdette speculates that Ashbrook, generally well-addressed.
- The pyx that were not assayed, and numismatic historian Roger Burdette speculates that Ashbrook, generally well-addressed.
- The cricket historian Derek Birley notes that many of these bowlers imitated the methods of
- Critic Roberta Reeder notes that the early poems always attracted large numbers of admirers
- The figures for the last two years are not available, but SF historian Mike Ashley estimates that fantastic paid circulation may have been as low as 13@.
- Aesthetically, IGN’s tal blevins noted that the game had” a very distinct 40s
- SF historian Everett Bleiler notes that Hersey did not mention the venture in his
- Similarly, Duke University professor, mark anthony Neal, writes, “nas was at the forefront of a renaissance
- Club reviewer Erik Adams wrote that the episode was a perfect mix, between the more subtle
- Commenting on the album and its use of samples, pitchfork’s Jeff Weiss claims that both nas and his producers found inspiration for the album
- The historian Stanley Karnow said of Ky and Thi: “both fl
- That were not assayed, and numismatic historian Roger Burdette speculates that Ashbrook, generally well-addressed
- Irataba was described as an eloquent speaker, and linguist Leanne Hinton suggests that he was among the first Mohave people to

Transformer factor 134 in layer 10
Explanation: Transition sentence

- Fanny Workman have tended to slight or belittle her achievements, but contemporaries, unaware of the far greater accomplishments to come, held the workmans
- Scheduled to air in its regular half-hour time slot, but NBC later announced it would be expanded to fill an hour time slot beginning a
- Wine and savory cabbage with a red wine and smoked chocolate sauce, but he otherwise felt that the food was” over-worked” and the
- Lap melee when he was hit by Romain Grosjean; Webber was forced to pit straight away, while Grosjean was given a ten@.
- Ra. one was initially scheduled to release on 3 June 2011, but delays due to a lengthy post-production process and escalating
- Yamina nomads who were centered at Tutul, and the rebels were supported by Yamhad’s king sumu-ad.
- The item was intended simply as a piece of news, but telegraph lines quickly spread the news throughout the state, fueling procession sentiment.
- Both TWC and Comcast began trials of services based on the system; Turner Broadcasting was an early supporter of the system, providing access to TBS and
- K> have claimed that he proposed a dictatorship for Robespierre, but nonetheless some of them considered him to be redeemable, or at least
- @ 2 style with superfiring pairs of turrets fore and aft; the middle turrets were not superfiring, and had a funnel between them.
- Romani being ordered to move out with supplies for the advancing troops, but 150 men, most of whom were past the end of their contracts and entitled to
- ’s boats to enter the creek into which the schooner had fled, the small craft entering the waterway in the hope of storming and capturing the vessel
- @ Person shooter elements and a unique on rails control scheme, but the core adventure style gameplay has been compared to Myst and Snatch
- Stanza 6; movement 4 incorporates ideas from stanzas 7 – 14, and movement 5 relies on stanzas 15 and< unk> movement 2,
- As corps troops that were usually allocated at a rate of one per division; several of the militia units were also later designated Australian Imperial Force units, after
Transformer factor 152 in layer 10
Explaination: in some locations

• while most breeding stallions and racehorses of the era had stable companions, waxy reportedly was fond of rabbits in his later years and
• planet and the helter skelter music bookshop have also been based on the street.
• the central bank of somalia, the national monetary authority, also has its headquarters in mogadishu.
• some allotropes of the other actinides also exhibit similar behaviour, though to a lesser degree.
• ; fortune 1000 technology company< unk>, for instance, is headquartered in the area.
• musical@-@ comedy television series maid marian and her merry men were filmed in cleve abbey.
• ireland,< unk> and donegal bay in particular, have popular surfing beaches, being fully exposed to the atlantic ocean.
• lstoy’s war and peace and chekhov’s peasants both feature scenes in which wolves are hunted with hounds and< unk>.
• while most breeding stallions and racehorses of the era had stable companions, waxy reportedly was fond of rabbits in his later years and"
• the lancashire and england test cricketer paul allott was born in altrincham.
• asura, the demon devotee of shiva, are both credited with building temples or cut caves to live.
• forbidden planet and the helter skelter music bookshop have also been based on the street.
• thopedic shriners hospitals in the u. s. is also located in spokane.
• dykes to watch out for and fun home, was born in lock haven in 1960.
• < unk>, and alessandra ambrosio have each worn two fantasy bras.

This is the end of visualization of mid level transformer factor. Click [D] to go back.
High-Level Transformer Factors

**Transformer factor 297 in layer 10 with saliency map**

**Explanation:** repetitive structure detector

frontier works, and an original soundtrack by avex group were created based on the game. drama [cd: tales of graces[1-4]] are side stories that take place during the game's plot. they were released between may 26, 2010 and august 25, 2010.

**Anthology drama cd:** tales of graces f 2010 winter, anthology drama cd: tales of graces f 2011 summer, anthology drama cd: tales of graces f 2012 winter, anthology drama cd: tales of graces f 2012 summer, anthology drama cd: tales of graces f 2013 winter, and anthology drama cd: tales of graces f 2013 summer.

**Cobra nd platinum cardholders,** and **citibank eva air cobra nd world card** the infinity (infinity mileagelands diamond, royal laurel/ premium laurel class passengers, star alliance first/ business class passengers, american express centurion/ eva air cobra nd platinum cardholders, citibank eva air cobra nd world cardholders) the star( infinity mileagelands diamond/ gold, royal laurel/ premium laurel class passengers, star alliance first/ business class passengers, star alliance gold members, american express centurion/ eva air cobra nd platinum cardholders, citibank eva air cobra nd world cardholders, business customers)

quickly set online< unk> alight". "can't get you out of my head" was chosen as the lead single from minogue's eighth studio album fever, and it was released on 8 september 2001 by par lophone in australia, while in the united kingdom and other european countries it was released on 17 september. "can't get you out of my head" was written and produced by cathy dennis and rob davis, who had been put together by british artist manager simon fuller, who wanted the duo to come up with a song for british pop group s club 7. the song was recorded using cuba

**Typhoon status** with two @ - @ minute sustained winds estimated at 125 km/ h(78 mph). around 1700 utc on may 31, the storm tracked approximately 65 km(40 mi) west of iwo jim a. roughly five hours later, it moved within 15 km (10 mi) of chi chi @ - @ jim a where a pressure of 992 mb( hpa; 29.30 inhg) was measured. sustained winds on chi chi @ - @ jim a reached 95 km/ h(60 mph); however, these were determined to be unrepresentative of lucille's actual intensity due to breaking eight weeks at number one on the airplay chart of the country and became the first to garner 3000 radio plays in a single week. subsequently, it became the most@-@ played song of 2001 in the region." can't get you out of my head" was certified platinum by the british phonographic industry for shipments of 600@,@ 000 units in 2001. the certification was upgraded to double@-@ platinum in 2015, denoting shipments of 1@,@ 200@,@ 000 units. in the united states, "can't get you out of my head" peaked at number seven on the chart. in mid@-@ august 2015, "la mor di dit a" earned martin his twenty@-@ sixth top ten hit on hot latin songs. he became the fourth artist with the most top tens in the 29@-@ year history of the chart. in late august 2015, martin earned with "la mor di dit a" his fifteenth number@-@ one on the latin airplay chart (up 58 percent, to 11@ @ 8 million audience impressions). eventually," la mor di dit a" peaked at number six on the us hot latin songs chart, number
one on latin airpl and

was delivered to sukhoi’s experimental workshop to be outfitted with exclusive systems. built by knaapo, its structure has increased carbon fibre and al li content. installed was the 2d thrust vector ing 1 yu lka al @ @ 31fp, an interim measure pending the availability of the al @ @ 37fu(< unk>< unk>, “ after burn er @ @ controlled”). the 3d thrust vector ing 1 yu lka al @ @ 37 fu was still in development. the al @ @ 31fp, in
e ke’s former band, though escape the fate only charted at number 25, seven spots lower than the drug in me is you, despite equal sales. in its second week on sales, the drug in me is you dropped about 70% in the united states, selling 870 copies. this dropped the album 60 spots to number 79 on the billboard 200, and brought total us sales for the album to around 24 000 copies. on the billboard charts, the drug in me is you charted at number three on the top hard rock albums chart, number three on the top alternative albums and top rock albums charts,

no, no, no, “ reached number one on the billboard hot & b/ hip @ @ hop singles& tracks and number three on the billboard hot 100. its follow @ @ up single,” with me part 1” failed to reproduce the success of no, no, no”. meanwhile, the group featured on a song from the soundtrack album of the romantic drama why do fools fall in love and” get on the bus” had a limited release in europe and other markets. in 1998, destiny’s child garnered three soul train lady of soul awards including best new artist for ” no, no, no

oistic warm ongers. alexander k rivenko( jonathan adams) finally, introduced in trivial games and paranoid pursuits, is russian alexander k rivenko, the commander of the moonbase where the ispf have their headquarters. a winner of the nobel prize for medicine, it is k riven ko’s research into bone damage that has contributed to enabling humanity to access space easily. although the star cops are independent, spring’s relationship with k rivenko is often def er ntial and he frequently seems to cap it u late to k ri ven ko’s wishes. == production history==

that build faith: from the life and ministry of thomas s. monson, salt lake city, utah: des ere t book, isbn 978 @ - @ 087579 @ - @ 901 @ - @ 8 — ( 1996), faith rewarded: a personal account of prophetic promises to the east german saints, salt lake city, utah: des ere t book, isbn 978 @ - @ 1-57345-186-@ - 4 — —( 1997 ), invitation to exaltation, salt lake city, utah: des ere t book, isbn 978 @ - @

dell, tom( 2015). gunnerkrigg court volume 5:< unk> gunnerkrigg court. arch aia studios press. isbn 978 @ - @ < unk >. == side comics== siddell, tom( 2013). an nnie in the forest part one. beyond the walls. robot voice comics. siddell, tom( 2013). an nnie in the forest part two. beyond the walls. robot voice comics. siddell, tom( 2015). traveller. beyond the walls. robot voice comics. == ex planatory footnotes======

95 @.@ 4 kn) f 40 2 @ - @ rr @ - @ < unk> engine, while later examples were fitted with the 23 @.@ 000 lb( 105 @.@ 8 kn) f 40 2 @ - @ rr @ - @ 40 8 a, in the early 2000s, 17 tav @ - @ 8 bs were upgraded to include a night @ - @ attack capability, the f 402 @ - @ rr @ - @ 408 engine, and software and structural changes.< unk> in 1991, the night attack harrier was the first upgrade of the av @ - @ 8

air tus’ meeting with ti’ ana, and the birth of their son gehn. the book also explains the destruction of the d ni civilization. two d ni, veovis and a’ gaeris, plot to destroy their civilization, which they believe has been corrupted. veovis is and a’ gaeris create a plague which wipes out many of the d ni and follows them through the ages. veovis is
murdered by a ' gaeris for refusing to write an age where the two of them would have been worshipped as gods, and aitrus sacrifices himself in order to

in response to the dumping incidents, the gb rm pa stated: we have strongly encouraged the company to investigate options that don’t entail releasing the material to the environment and to develop a management plan to eliminate this potential hazard; however, gb rm pa does not have legislative control over how the tailings dam is managed.==== following a of warped tour, following this, a lesson in romanticas was released on july 10 through fearless records. in august, the band went on tour with olympia and sound the alarm. the music video for “when i get home, you’re so dead”, directed by marco de la torre, was filmed in september. in late september 2007, the band supported paramore in japan and australia. the band went on a co-headlining tour with madina lake in october and november. the “when i get home, you’re so dead” music video was released on november 14, and the single was released on

of the english football league including promotion and relegation. the player’s team begins with a low rating in an 8 @ - @ team league. by winning games, the player earns credits, which can be used to purchase the contracts of free agents. by finishing high in the 8 @ - @ team league, the player’s team advances to a 16@-@ team league and eventually a 32@-@ team league: the player improves their team by periodically signing free agents as the competition is tougher in each league. the player wins the mode after winning a playoff tournament in the 32@-@ team league

Transformer factor 322 in layer 10 with saliency map
Explanation: biography, someone born in some year...
1890. = = early years = = get ze in was born in 1864 and telegraph lines and networks. the west construction company, based in chattanooga, tennessee, was a general contracting and construction firm also involved in the operation and maintenance of railway, telephone, and telegraph lines.

== personal life == marriage and children == on april 10, 1875, in hampshire county, flournoy married frances "fannie" ann armstrong white (april 10, 1844–february 25, 1922), the daughter of hampshire county clerk of court john baker white and his wife frances ann streit white. frances white’s brother, robert white, served as west virginia attorney general, and her buffalo, new york businessman who made his fortune in five @-@ and @-@ dime stores. he merged his more than 100 stores with those of his first cousins, frank winfield woolworth and charles woolworth, to form the f. w. woolworth company. he went on to hold prominent positions in the merged company as well as marine trust co. he was the father of seymour h. knox ii and grandfather of seymour h. knox iii and northrup knox, the co-founders of the buffalo sabres in the national hockey league.

== biography == he was born in april 1861 in russell, saint lawrence stars for eighteen years. the american film institute(afi) ranked cooper eleventh on its list of the twenty five greatest male stars of classic hollywood cinema.

== early life == frank james cooper was born on may 7, 1901, at 730 eleventh avenue in helena, montana to english immigrants alice (nee brazier, 1873–1967) and charles henry cooper (1865–1946). his father emigrated from houghton regis, bedfordshire and became a prominent lawyer, rancher, and eventually a montana supreme court justice. his mother emigrated from gillingham, kent and married charles in montana. in 1906, charles purchased the 600@-@ acre orange (1971), which kubrick pulled from circulation in the uk following a mass media frenzy — most of his films were nominated for oscars, golden globes, or bafta awards. his last film, eyes wide shut, was completed shortly before his death in 1999.

== early life == stanley kubrick was born on july 26, 1928, in the lying @-@ in hospital at 307 second avenue in manhattan, new york city. he was the first of two children of jacob leonard kubrick (may 21, 1862–october 19, 1985), known as jack or jacques, and his wife sadie gertrude kubrick managed with a catch and release regulation. trophy trout and wild brook trout enhancement regulations apply to the remainder. a total of 31 class a wild trout waters have been designated as wilderness trout streams. fishing in class a wild trout waters is permitted year@-@ round, although the killing of fish is forbidden from labor day to the beginning of the following year’s trout season.

== gallery == henry bell gilkes on = henry bell gilkes on (june 6, 1856 – september 29, 1921) was an american lawyer, politician, school administrator, and banker in west virginia. gilkeson was born in moorefield, movement, there have been few more remarkable figures than marjory stoneman douglas.== early life == marjory stone man was born on april 7, 1890, in minneapolis, minnesota, the only child of frank bryant stoneman (1857–1941) and lillian trefethen (1859–1912), a concert violinist. one of her earliest memories was her father reading to her the song of hiawatha, at which she burst into sobs upon hearing that the tree had to give its life in order to provide hiawatha the wood for a canoe. she was an early and voracious reader.
war i, and served with austro-hungarian forces on the eastern and italian fronts as company commander in the imperial royal mountain troops during world war i he was decorated several times for bravery and leadership, and very unusual properties, such as a quantum critical point behavior, exotic superconductivity, and high-temperature ferromagnetism. babe ruth was born on february 6, 1895, in st. cloud, minnesota, the second son of george ann ( foster) and edward shaughnessy. he attended north st. paul high school, and prior to college, had no athletic experience. when he attended the university of minnesota, however, he played college football under head coach henry l. williams and alongside halfback bernie bierman. shaughnessy considered williams to be football’s greatest teacher, and williams considered him to be the best passer from the midwest. shaughnessy handled both the passing and kicking duties for the team. he played on air in regular scheduled services. it includes the city, country, airport and the period in which the airline served the airport. hubs are denoted with a dagger().

early life = = = gregoras likewise avoids negative comments, as do most modern historians = = = george nico l (baseball) = = = george edward nico l (october 17, 1870 – august 4, 1924) was an american baseball pitcher and outfielder who played three seasons in major league baseball( mlb) = = = he played for the st. louis browns, chicago colts, pittsburgh pirates and louisville colonels from 1890 to 1894 = = = possessing the rare combination of batting right-handed and throwing left-handed, he served primarily as a right fielder when he did not pitch = = = signed by the browns without having previously played any minor league baseball, nico l made his dispatched powell and major benjamin mcculloch to utah to ease tensions with brigham young and the mormons. powell assumed his senate seat on his return from utah, just prior to the election of abraham lincoln as president. powell became an outspoken critic of lincoln’s administration, so much so that the kentucky general assembly asked for his resignation and some of his fellow senators tried to have him expelled from the body. both groups later renounced their actions. powell died at his home near henderson, kentucky shortly following a failed bid to return to the senate in 1867. = = = early life = = = powell was born on october 6, 1812, near henderson, the army in 1948. he was promoted to
lieutenant general just before his retirement on 29 February 1948 in recognition of his leadership of the bomb program. by a special act of congress, his date of rank was backdated to 16 July 1945, the date of the Trinity nuclear test. Groves went on to become a vice-president at Sperry Rand.

Early life

Leslie Richard Groves Jr. was born in Albany, New York, on 17 August 1896, the third son of four children of a pastor, Leslie Richard Groves Sr. and his wife Gwen Nee Griffith, a descendant of French Huguenots. Burns died on November 11, 1928 in Brooklyn, New York.

Biography

Thomas P. Burns was born on September 6, 1864, in Philadelphia. His parents, Patrick and Mary Burns, were both Irish immigrants. In 1883, Burns began his professional baseball career as a pitcher with Harrisburg of the minor-league Interstate Association. On the year, Burns posted an earned run average (ERA) of 2.30 over 20 games pitched, 15 of which were starts. When he wasn’t pitching, Burns played second and third base. Burns began the 1884 season playing for the Wilmington Quicksteps.

Credits and Personnel

Lady Gaga – vocals, songwriter and producer Redone – songwriter, producer, vocal editing, vocal arrangement, audio engineering, instrumentation, programming, and recording at Tour Bus in Europe. Trevor Muzy – recording, vocal editing, audio engineering, and audio mixing at Larrabee, North Hollywood, Los Angeles, California. Gene Grimaldi – audio mastering at Oasis Mastering, Burbank, California. Anderson was a professional accordion player and wrote poetry for various American Pagan magazines. In 1970, he published his first book of poetry, Thorns of the Blood Rose, which contained devotional religious poetry dedicated to the goddess; it won the Clove International Poetry Competition Award in 1975. Anderson continued to promote the Feri tradition until his death, at which point April Niino was appointed as the new Grandmaster of the tradition.

Childhood: 1917–1931

Anderson was born on May 21, 1917, at the buffalo horn ranch in Clayton, New Mexico. His parents were Hildart Alexander Anderson and Gladys <UNK> Monson. The second of six children, he grew up in a “tight-knit” family — many of his mother’s relatives were devoutly religious, and pro-@-@ temperance.

Which took delivery of its eight and last Globemaster in November 2015; No. 38 Squadron, operating King Airs; and the Australian Army’s 68 Ground Liaison Section. All units are based at Amberley, with the exception of No. 38 squadron, located at Townsville. Clark Shaughnessy = Clark Daniel Shaughnessy (originally O’ Shaughnessy) was an American football coach and innovator; he is sometimes called the “father of the T formation” and the
original founder of the forward pass, although that system had previously been used as early as the 1880s

Transformer factor 386 in layer 10 with saliency map
Explanation: topic: war

he was awarded a companion of the order of st michael and st george for his command of the 4th machine gun battalion, the recommendation of which particularly citing his success during attacks on the hindenburg line. murray’s final honour came on 11 july 1919, when he was mentioned in despatches for the fourth time, having received his third mention on 31 december 1918. from june to september 1919, murray — along with fellow australian victoria cross recipient william donovan joynt — led parties of aif members on a tour of the farming districts of britain and denmark to study agricultural methods under the education schemes. after touring through france and belgium,

from large calibre shells; one of them, allegedly a 14 inch (356 mm) round, blew a large hole in her quarterdeck and wrecked the wardroom and the gunroom. she also took several hits by light shells that day, and, although she suffered damage to her superstructure, her fighting and steaming capabilities were not seriously impaired. the ship also participated in the main attack on the dardanelles forts on 18 march. this time a 6 inch (152 mm) howitzer battery opened fire on agamemnon and hit her 12 times in 25 minutes; five of the

. lt. riefkohl, who was also the first puerto rican to graduate from the united states naval academy, served as a rear admiral in world war ii. frederick l. riefkohl’s brother, rudolph william riefkohl also served. riefkohl was commissioned a second lieutenant and assigned to the 63rd heavy artillery regiment in france where he actively partici-pated in the meuse-argonne offensive. according to the united states war department, after the war he served as captain of coastal artillery at the letterman army medical center in presidio of san francisco, in california( 1918).
veteran transport loaded troops at saint nazaire
@ july, met his wife in new york, and together they traveled to columbus, georgia by way of washington, d. c. and atlanta = military schools== for the ten years following world war i, troy middleton would be either an instructor or a student in the succession of military schools that army officers attend during their careers. middleton arrived in columbus, georgia with strong praise from his superiors, and would soon get his efficiency report, in which brigadier general benjamin poore e of the 4th division wrote of him, "the best all @-@ around officer i have yet seen." by his rapid promotion from coal and 700 long tons ( 710 t) of fuel oil and that provided her a range of 3@, 500 nautical miles ( 6@, 500 km) at a speed of 10 knots ( 19 km/ h), her main armament consisted of a dozen obukhovskii 12@-@ inch ( 305 mm ) pattern 1907 52 @ -@ re gul ib re guns mounted in four triple turrets distributed the length of the ship, the russians did not believe that super firing turrets offered any advantage as they discounted the value of axial fire and believed that super firing turrets could not fire while over the lower turret because of the harsh conditions of desert warfare had begun to affect mickl's health, so at the end of december he was sent home on convalescent leave. in an allied air raid on 10 december 1941, mickl was appointed to temporarily command the division. during december, mickl was wounded in the head and hand, but remained at his post. ro mel recommended mickl for the knight' s cross of the iron cross, for his leadership at sidi rezegh, and it was duly awarded on 13 december 1941. the conditions of desert warfare had begun to affect mickl's health, so at the end of december he was sent home on convalescent leave. in an allied air raid on 10 december 1941, mickl was appointed to temporarily command the division. during december, mickl was wounded in the head and hand, but remained at his post. ro mel recommended mickl for the knight' s cross of the iron 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up defensive positions to block any potential counter-attack and patrols went into the immediate jungle in search of any west side boys hiding in the bushes, the village was completely secure by 08:00 and the paras secured the approaches with clay more.

she was able to reach a speed of 21.75 knots (40.28 km/h; 25.03 mph). a brief refit in early 1927 saw the addition of two more four - inch guns and the removal of the six - inch guns from the shelter deck. about 1931, a high - angle control became enraged at him, slapping him across the face. he began yelling: "your nerves, hell, you are just a goddamned coward. shut up that goddamned crying. i won’t have these brave men who have been shot at seeing this yellow bastard sitting here crying." patton then reportedly slapped bennett again, knocking his helmet liner off, and ordered the receiving officer, major charles b. etter, not to admit him. patton then threatened bennett, "you’re going back to the front lines and you may get shot and killed, but you’re going to fight. if you don’t, i’ll secondary guns, two of which were disabled. the ammunition stores for these two guns were set on fire and the magazines had to be flooded to prevent an explosion. the ship nevertheless remained combat effective, as her primary battery remained in operation, as did most of her secondary guns; konig could also steam at close to her maximum speed. other areas of the ship had to be counter-@ - @ flooded to maintain stability; 1,600 tons of water entered the ship, either as a result of battle damage or counter -@ - @ flooding efforts. the flooding rendered the battleship sufficiently low in the water to prevent the ship from being able in 1924 and rice institute, houston, texas in 1928, he dropped out of graduate school after one year and decided to hitchhike to san francisco. the lack of work meant hunger, so he chose to join the united states army’s 11th cavalry regiment as a private on july 30, 1930, serving in monterey, california. after a year in the horse cavalry, par rish became an aviation cadet in june 1931 and subsequently qua liﬁed as an enlisted pilot, he completed flight training in 1932 and was assigned to the 13th attack squadron at fort crock ett, near galveston, texas. one year later in september 1933 parrish during the battle, murray was awarded the victoria cross. soon after his victoria cross action, he was promoted to major and earned a bar to his distinguished service order during an attack on the hindenburg line near bullecourt. promoted to lieutenant colonel in early 1918, he assumed command of the 4th machine gun battalion, where he would remain until the end of the war, returning to australia in 1920, murray eventually settled in queensland, where he purchased the grazing farm that would be his home for the remainder of his life. re-@-@ enlisting for service in the second world war, he was appointed as commanding officer 10 officers and 315 enlisted men, plus an additional four officers and 19 enlisted men if serving as a flotilla flagship. == construction and career== the ship was ordered on 7 july 1934 and laid down at deutsche werke, kiel, on 2 january 1935 as yard number< unk>. she was launched on 30 november 1935 and completed on 8 april 1937. she was named after max schultz who commanded the torpedo boat< unk> and was killed in action in january 1917. korvet ten ka pitan martin< unk> was appointed as her first captain. max schultz was assigned to the 1st destroyer division on 26 the command of otto von diederichs. the squadron participated in the fall maneuvers in 1894, which simulated a two@-@ front war against france and russia; deutschland’ s
squadron acted as the Russian fleet during the exercises. Between 1894 and 1897, Deutschland was rebuilt in the imperial dockyard in Wilhelmshaven. The ship was converted into an armored cruiser; her heavy guns were removed and replaced with lighter weapons, including eight 15 cm (5.9 in) and eight 8 cm (3.1 in) guns. Her entire rigging equipment was removed and two heavy military masts were installed.

called on many times to maintain order in times of disaster and to keep peace during periods of political unrest. Oklahoma Governor John C. Walton used division troops to prevent the state legislature from meeting when they were preparing to impeach him in 1923. Governor William H. Murray called out the guard several times during the depression to close banks, distribute food and once to force the state of Texas to keep open a free bridge over the Red River which Texas intended to collect tolls for, even after federal courts ordered the bridge not be opened. The division would go on to see combat in World War II as one of four National Guard divisions active during World War II.

Transformer factor 170 in layer 10 with saliency map
Explanation: topic: music production

2nd street tunnel and part of downtown Los Angeles spread out over a 48-hour period. Kesha explained the idea behind the video as well as the experience during an interview with MTV news: she said that the video was different from her other videos, noting that she was going to show a sexier side of herself. The music video for "We r who we r" is presented as an underground party. The video starts off with futuristic flashing lights. Kesha, seen in a ponytail wearing gray and black makeup, chains, ripped stockings, and a sparkly one-piece leotard made of shards of broken glass and several European territories), her "endless love" duet with Luther van Dross (number-1 in New Zealand) and "Against All Odds" featuring Westlife (number-1 in the United Kingdom). "Thank God I Found You" was also omitted from the Japanese track listing, and replaced with "All I Want for Christmas is You." For the album artwork, Carey launched a social media campaign on April 12, 2015, whereby fans had to share a link to her website in order to reveal the cover which was concealed by a curtain using the hashtag <unk>.

The producer, few days after he had finished the composition, Madonna completed writing the lyrics of "I Don't Give A." Solveig understood that the lyrics were probable references towards Madonna's life and thus received coverage in the press. However, he was not aware of the inner meaning behind the lyrics. With Billboard magazine, the producer further explained: at first I thought we were going to work on one song; that was the original plan. Let's try to work on one song and take it from there—not spend too much time thinking about the legend, and do something that just makes sense.

Provided an additional and assistant engineering. All the instruments were provided by Ericsen and Hermansen while Dean sang the background vocals. In May 2011, in the mix review, an analyzing commercial productions, Mike senior of Sound On Sound revisited the original mixing of the song. According to him,
before he started the mix, senior played the song a couple of times before releasing what thing about it" bugged" him. working it out, he noted that the harmony of the mix is undermined by the kick drum. "what's my name?" contains basic harmonies that are a bar of f minor, a bar of a major.

practiced in their backyards and at < unk > salon, owned by knowles' mother, tina. the group would test routines in the salon, when it was on montrose boulevard in houston, and sometimes would collect tips from the customers. their try out would be critiqued by the people inside. during their school days, girl's ty me performed at local gigs. when summer came, mathew knowles established a "boot camp" to train them in dance and vocal lessons. after rigorous training, they began performing as opening acts for established r & b groups of that time such as swv, dru hill and immature. tina.

day reception at the greek embassy. upon return to greece, she was greeted at the airport by fans along with the music video of "my number one" playing on the video monitors. while in greece, she attended the opening ceremony of the european final four for the volleyball champions league in < unk >, where her song was played as she appeared on stage with cheerleaders. on march 29, paparizou arrived in valletta, malta where she signed autographs, appeared on television stations, and gave interviews to the local media. following malta, she traveled to serbia and montenegro where she gave additional interviews before moving on to and

and her low hip-@-@ grind during' rude boy' were the smash hits of her body language. "deborah linton of city life wrote that rihanna "even manages to make a psychiatric couch look sexy". linton called the show's stage sets impressive and imaginative. rick massimo of the providence journal wrote that rihanna "looked like a neon-@-@ sign rendition of herself during' rehab', rarely addressed the audience, and didn't rise above flat cliche in that until the very end of the show "rehab" and rihanna's 2009 single "Russian roulette" were excluded from the set only a few hours. he said: "there were a lot of tracks, but i just enjoyed it, to be honest. i knew how i wanted it to sound, and it was pretty much the last song we cut; a lot of the mixing was nailed in the production as well, which helped. dream did a great job producing this track, "the bar one guitar track of "school in life" was entirely programmed. similarly, the live drum section in the hook was actually done with programmed drums. once the mixing was over, swivel's impression were as follows: [i schoolin' life] absolutely tour began on march 1, 2000 at the house of blues in los angeles, while other venues included paris olympia, trump taj mahal, brixton academy, the montreux jazz festival, and the essence jazz festival in new orleans. by july, the tour's first half had sold out in each city. the tour lasted nearly eight months, while performances went for up to three hours a night. the voodoo tour was taken internationally, with one of the most notable performances being the free jazz festival in brazil. the music video for "untitled ( how does it feel )" portrayed d'angelo as a sex symbol

ho bson noted that rihanna "rejects the victim stance" in the video for "man down", and elucidated that she played the role of a rape survivor who shot her attacker. she attributed the location of shooting the video in jamaica as significant, due to how the image of a gun proliferated during 1990s jamaican dance hall's to" express female rage". the prologue depicts rihanna as a" dark @-@ hooded" femme fatale whereby the narrative explains her motives for murder and provokes the spectator to sympathize with her because she danced in a provocative manner with a man in a club, which

had a deep impact on delonge in that he spent a night up crying for him when he wrote the track. "a little 's enough " was
inspired by a religious concept in which a god came to bring positive change on earth when it faces terrorism, war or famine, an anthem about the iraq war and its death toll is succeeded by "it hurts," a track about a friend of de longe with a cheating girlfriend. it’s a terrible situation where my friend is being crushed from the inside out by all the manipulative stuff she’s doing and this song’s

just took that dress out of the storage – it has a 27-foot train and it was just all hand-beaded and stuff and so i figured we might as well get a use out of it.’

the video features carey ready ing for her wedding, and follows her to the altar, as well as her escape from the reception. many of the actors featured in carey’s “it’s like that” video were in that of “we belong together,” which was shot as a continuation from the" it’s like that” video. it begins with

3 in dutch-speaking flanders and number 2 in french-speaking wallonia, it was certified gold by the belgian entertainment association(bea) for selling more than 15,000 copies, although the song spent only 1 week on the italian singles chart (at number 8), it was certified platinum by the federazione industria musicale italiana(fimi) in 2014 for selling more than 30,000 copies.== music video ===== background and synopsis=== anthony man dler directed the music video for "man down" in april 2011 on a beach in

at numbers 18 and 43 in the united states and experienced moderate success worldwide. unlike her previous records, spears did not heavily promote blackout; her only televised appearance for blackout was a universally panned performance of "give me all your luv" in november 2003, while promoting her fourth studio album in the zone, spears told entertainment weekly that she was already writing songs for her next album and was also hoping to start her own record label in 2004. henrik jonback confirmed that he had written songs with her during the european leg of the onyx hotel tour.

of albums also had increased sales due to discounting and publicity generated by the single and her performance. billboard estimated that her top 10 digital sales collectively increased over 1@700 percent. madonna’s bestselling album was the 2009 greatest hits collection, celebration, which sold 16,000 copies (up 1,341 percent) and reentered the billboard 200 album chart. the following week celebration fell 105 spots on the chart to number 157, with sales falling to 4,000 copies.== music video ===== background and synopsis=== anthony man dler directed the music video for "man down" in april 2011 on a beach in

married and after the wedding, she told the press that she didn’t know she had." from the moment she was signed in the film, madonna had expressed interest in recording a dance version of "don’t cry for me argentina," according to her publicist liz rosenberg, “since she didn’t write the music and lyrics, she wanted her signature on that song....
Stage played up the "ominous" tone of the song as it gradually increased its tempo to the point whereby the end of the song was on the verge of sounding like an incantation, for the Diamonds world tour, Rihanna performed "Man Down" in a Caribbean-themed section of the show, which also included "You Da One," "No Love Allowed," "What's My Name?" and "Rude Boy." James Lachno of the Telegraph highlight the Caribbean-themed edge of several realities: the film, the dream it inspires, the waking world it illuminates.

The music in "I Just Can't Stop Loving You," a duet with Siedah Garrett, consisted mainly of finger snaps and timpani. "Just Good Friends," a duet with Stevie Wonder, was viewed by critics as sounding good at the beginning of the song, ending with a "chin @-@ bobbing cheerfulness." "The Way You Make Me Feel"'s music consisted of blues harmonies. The lyrics of "Another Part of Me" deal with being united, as "we not manufactured, no one paid these kids." "What Makes You Beautiful" on red or black? On 10 September 2011, the performance started with hosts Ant & Dec announcing that the band was supposedly running late for their appearance, and cut to a video of One Direction boarding a London tube carriage full of fans, as the studio version of the song began playing. Each fan on the tube was given a numbered ticket. The band and fans disembarked the tube and made their way to the television studio, where the remainder of the song was sung live after the song.

This is the end of visualization of high-level transformer factor. Click [D] to go back.