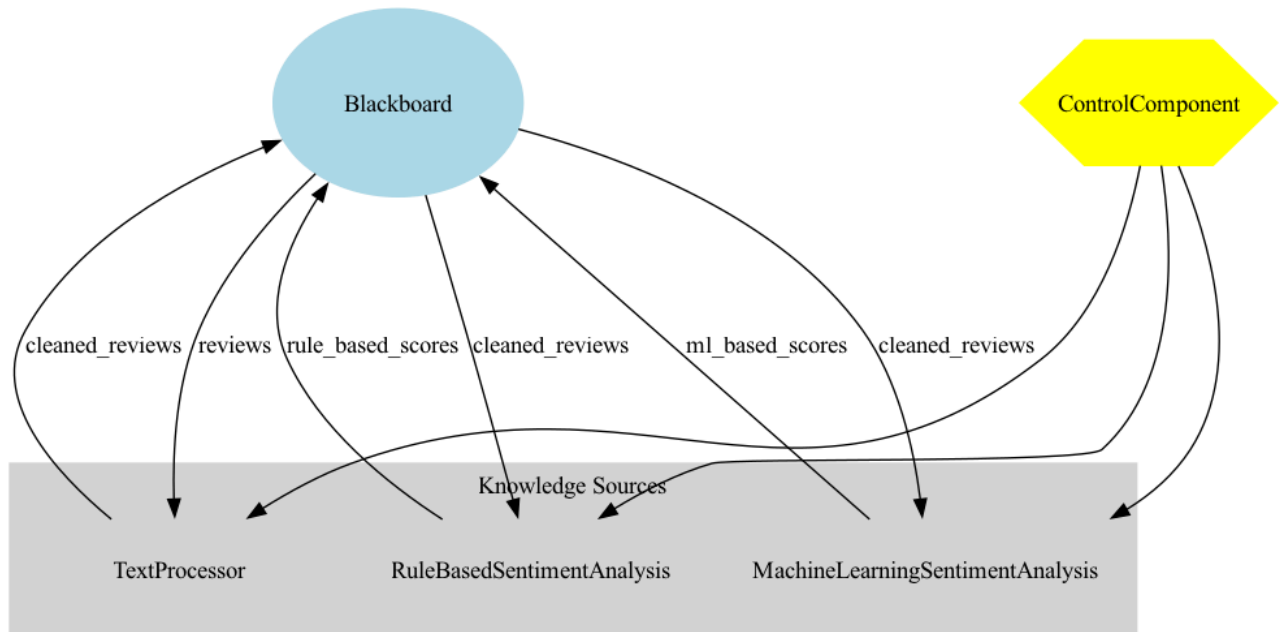


Blackboard Architecture Demonstration (Sentiment Analysis)



```
In [2]: import os
import nltk
from nltk.sentiment.vader import SentimentIntensityAnalyzer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import LogisticRegression
import pandas as pd
import re
```

```
In [3]: nltk.download('vader_lexicon')
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data] /Users/ruresh/nltk_data...
[nltk_data] Package vader_lexicon is already up-to-date!
```

```
Out[3]: True
```

```
In [4]: class Blackboard:
def __init__(self):
    self.data = {
        'reviews': [],
        'cleaned_reviews': [],
        'rule_based_scores': [],
        'ml_based_scores': [],
        'final_sentiments': []
    }

def update(self, key, value):
    if key in self.data and isinstance(self.data[key], list):
        self.data[key].extend(value)
    else:
        self.data[key] = value

def read(self, key):
    return self.data.get(key)
```

```
In [5]: class KnowledgeSource:
def __init__(self, blackboard):
    self.blackboard = blackboard
```

```
def act(self):
    raise NotImplementedError
```

```
In [6]: # Basic Text Processing KS
class TextProcessor(KnowledgeSource):
    def act(self):
        reviews = self.blackboard.read('reviews')
        cleaned_reviews = [self.clean_text(review) for review in reviews]
        self.blackboard.update('cleaned_reviews', cleaned_reviews)

    def clean_text(self, text):
        text = re.sub(r'<.*?>', ' ', text)
        text = re.sub(r'^a-zA-Z\s', ' ', text)
        text = text.lower().strip()
        return text

# Rule-Based Sentiment Analysis KS
class RuleBasedSentimentAnalysis(KnowledgeSource):
    def __init__(self, blackboard):
        super().__init__(blackboard)
        self.analyzer = SentimentIntensityAnalyzer()

    def act(self):
        cleaned_reviews = self.blackboard.read('cleaned_reviews')
        scores = [self.analyzer.polarity_scores(review)['compound'] for review in cleaned_reviews]
        sentiments = ['positive' if score >= 0 else 'negative' for score in scores]
        self.blackboard.update('rule_based_scores', sentiments)

# Machine Learning Sentiment Analysis KS
class MachineLearningSentimentAnalysis(KnowledgeSource):
    def __init__(self, blackboard):
        super().__init__(blackboard)
        self.vectorizer = TfidfVectorizer(max_features=5000)
        self.model = LogisticRegression()

    def train(self, reviews, labels):
        vectors = self.vectorizer.fit_transform(reviews)
        self.model.fit(vectors, labels)

    def act(self):
        cleaned_reviews = self.blackboard.read('cleaned_reviews')
        vectors = self.vectorizer.transform(cleaned_reviews)
        sentiments = self.model.predict(vectors)
        self.blackboard.update('ml_based_scores', sentiments)
```

```
In [7]: class ControlComponent:
    def __init__(self, blackboard, knowledge_sources):
        self.blackboard = blackboard
        self.knowledge_sources = knowledge_sources

    def run(self):
        for ks in self.knowledge_sources:
            ks.act()
```

```
In [8]: # Instantiate the system components
blackboard = Blackboard()

# Load IMDb dataset
def load_imdb_dataset():
    # Read positive reviews
    pos_reviews = []
    for filename in os.listdir('dataset/train/pos'):
        with open(os.path.join('dataset/train/pos', filename), 'r', encoding='utf-8') as f:
            pos_reviews.append(f.read())
```

```

# Read negative reviews
neg_reviews = []
for filename in os.listdir('dataset/train/neg'):
    with open(os.path.join('dataset/train/neg', filename), 'r', encoding='utf-8')
        neg_reviews.append(file.read())

return pos_reviews, neg_reviews

# Preprocess data for simplicity
pos_reviews, neg_reviews = load_imdb_dataset()
reviews = pos_reviews + neg_reviews
labels = [1] * len(pos_reviews) + [0] * len(neg_reviews)
df = pd.DataFrame({'review': reviews, 'sentiment': labels})
df = df.sample(100) # Use a smaller sample for demonstration

blackboard.update('reviews', df['review'].tolist())

# Create knowledge sources
text_processor = TextProcessor(blackboard)
rule_based_sa = RuleBasedSentimentAnalysis(blackboard)
ml_based_sa = MachineLearningSentimentAnalysis(blackboard)

# Train ML model
ml_based_sa.train(df['review'].tolist(), df['sentiment'].tolist())

knowledge_sources = [text_processor, rule_based_sa, ml_based_sa]

# Run the control component
control = ControlComponent(blackboard, knowledge_sources)
control.run()

# Output the final state of the blackboard
# print("\nFinal Blackboard State:")
# print(blackboard.data)

```

In [9]: `blackboard.data.keys()`

Out[9]: `dict_keys(['reviews', 'cleaned_reviews', 'rule_based_scores', 'ml_based_scores', 'final_sentiments'])`

In [10]: `blackboard.data['reviews'][:5]`

Out[10]: I'd LOC could have been a very well made movie on how the Kargil war was fought; it had the locations, the budget, and the skill to have been India's "Saving Private Ryan" or "Black Hawk Down". Instead it come across as a bloated, 4 hour bore of trying to meld the war movie with the masala movie. Even the war scenes were terribly executed, using the same hill in all their battle scenes, and spending unnecessary time on casual talk. Instead of trying to appeal to the Indian public, a better movie would have been a to-the-book account of what happened at Kargil (like "Black Hawk Down") or even spending time on the militant point of view (like "Tora, Tora, Tora"). Even better, it could have used a competent director like Ram Gopal Verma to write, direct and edit the film. Until then, I'd like to see some one re-edit this film, with only the pertinent portions included; it would make the movie more watchable.',

'This was a wonderful little American propaganda film that is both highly creative AND openly discusses the Nazi atrocities before the entire extent of the death camps were revealed. While late 1944 and into 1945 would reveal just how evil and horrific they were, this film, unlike other Hollywood films to date, is the most brutally honest film of the era I have seen regarding Nazi atrocities.

The film begins in a courtroom in the future--after the war is over (the film was made in 1944--the war ended in May, 1945). In this fictitious world court, a Nazi leader is being tried for war crimes. Wilhelm Grimm is totally unrepentant and one by one witnesses are called who reveal Grimm's life since 1919 in a series of flashbacks. At first, it appears that the film is going to be sympathetic or explain how Grimm was pushed to join the Nazis. However, after a while, it becomes very apparent that Grimm is just a sadistic monster. These episodes are amazingly well done and definitely hold your interest and also make the film seem less like a piece of propaganda but a legitimate drama.

All in all, the film does a great job considering the film mostly stars second-tier actors. There are many compelling scenes and performances--especially the very prescient Jewish extermination scene towards the end that can't help but bring you close to tears. It was also interesting how around the same point in the film there were some super-creative scenes that use crosses in a way you might not notice at first. Overall, it's a must-see for history lovers and anyone who wants to see a good film.

FYI--This is not meant as a serious criticism of the film, but Hitler was referred to as "that paper hanger". This is a reference to the myth that Hitler had once made money putting up wallpaper. This is in fact NOT true--previously he'd been a "starving artist", homeless person and served well in the German army in WWI. A horrible person, yes, but never a paper hanger!'

"This is a wonderful movie about the struggle of the Mormons and their final settlement in Salt Lake, Utah. The beginning and the ending are especially powerful, and the message is one we all have to be reminded of - God doesn't talk, but he communicates, if we would only listen. As I am writing this in the midst of the horrors going on in New Orleans and the surrounding area due to Katrina, I was especially moved by the Mormons having to leave everything behind and move on after Joseph Smith was assassinated. People came to this country to escape religious persecution, and yet they could not. The struggle of the Mormons to cross the country, the cost in lives, the hardship they suffered was truly awe-inspiring, demonstrating their tremendous strength. As far as the actual beliefs of Mormons, this is not heavily gone into, and polygamy is mentioned but is not a centerpiece of the film at all.

The cast is top-notch, though others who have commented know more about the actual characters and can talk about how true the portrayals were. But as actors, Dean Cain, Mary McCormack, Brian Donlevy, John Carradine, Jane Darwell all do excellently with the script they were given.

Though the film could have easily stood on its own (and certainly does today) Tyrone Power and Linda Darnell were added to the cast to get the crowds into the movie theaters to see a film about the Mormons. Power is magnificently handsome as a young Mormon, and Darnell, as Zina, is not a Mormon but stays on with the family after her father is killed. Power does not have much to do until the end of the film, when he has a big scene, and Darnell (still a teenager at the time of the filming) has even less, though they make a lovely couple. Their fate is left unclear regarding her conversion, and one does wonder about the polygamy in their case. You can't beat either one for eye candy, however.",

"I just saw a press screening of this film and I was pleasantly surprised. Not often is it that I get to see all of my favorite actors in one film at one time.

I really enjoyed the pick pocket scene and it was good to see Rachael Bilson and Hayden back together. I think their chemistry on camera is a direct result of their time together off camera. My favorite scene was by far (surprisingly so) Bret Ratner's piece... Without giving too much away, I'll just say that there is a surprise that leaves you hanging...

The old couple were really good together and you

actually got the impression that they had spent a lifetime together.

Both the Chris Cooper and the Ethan Hawke segments packed a punch with surprises that seem realistic and similar to experiences that I've had in the big apple. Over all the film is a great place to take a date... especially if you're already fond of the city itself.

I can't wait for the next in the Cities of Love.",

"_Les Acteurs_ is the absurd story of Jean-Pierre Marielle desperately waiting for a cup of hot water, the story of a conspiracy against actors, the story of aging actors whose careers are slowly less active than they used to be, but a stunning tribute to French actors and their cinema.

Supported by a solid reflection about cinema and acting (the fourth wall, the hidden cameras, to play or not to play), the story of this film in which most of those famous actors play their own role (not to be mixed up with living their life in front of the camera – the film is not voyeur) is quite vague, and follows the actors in series of episodes which make the film quite amusing. As André Dussolier quits the film and leaves Josiane Balasko to play his part (great actress, she's hilariously serious especially when, in Dussolier's role, she bitchies about herself), as actors run in each other on the street, asking for autographs, as fights and gossip happen, we recognize pastiche of other scenes in which each (or others) have played.

Actually, for whoever does not know the actors (most of them being at least in their 50s) or does not know French Cinema, this movie has less interest, since most of the references will be missed, but it will still offer a good track of reflection on aging, on acting, on public life..."

```
In [11]: blackboard.data['cleaned_reviews'][:5]
```

Out[11]: ['loc could have been a very well made movie on how the kargil war was fought it had the locations the budget and the skill to have been india s saving private ryan or black hawk down instead it come across as a bloated hour bore of trying to meld the war movie with the masala movie even the war scenes were terribly executed using the same hill in all their battle scenes and spending unnecessary time on casual talk instead of trying to appeal to the indian public a better movie would have been a to the book account of what happened at kargil like black hawk down or even spending time on the militant point of view like tora tora tora even better it could have used a competent director like ram gopal verma to write direct and edit the film until then i d like to see some one re edit this film with only the pertinent portions included it would make the movie more watchable',

'this was a wonderful little american propaganda film that is both highly creative and openly discusses the nazi atrocities before the entire extent of the death camps were revealed while late and into would reveal just how evil and horrific they were this film unlike other hollywood films to date is the most brutally honest film of the era i have seen regarding nazi atrocities the film begins in a courtroom in the future after the war is over the film was made in the war ended in may in this fictitious world court a nazi leader is being tried for war crimes wilhelm grimm is totally unrepentant and one by one witnesses are called who reveal grimm s life since in a series of flashbacks at first it appears that the film is going to be sympathetic or explain how grimm was pushed to join the nazis however after a while it becomes very apparent that grimm is just a sadistic monster these episodes are amazingly well done and definitely hold your interest and also make the film seem less like a piece of propaganda but a legitimate drama all in all the film does a great job considering the film mostly stars second tier actors there are many compelling scenes and performances especially the very prescient jewish extermination scene towards the end that can t help but bring you close to tears it was also interesting how around the same point in the film there were some super creative scenes that use crosses in a way you might not notice at first overall it s a must see for history lovers and anyone who wants to see a good film fyi this is not meant as a serious criticism of the film but hitler was referred to as that paper hanger this is a reference to the myth that hitler had once made money putting up wallpaper this is in fact not true previously he d been a starving artist homeless person and served well in the german army in wwi a horrible person yes but never a paper hanger',

'this is a wonderful movie about the struggle of the mormons and their final settlement in salt lake utah the beginning and the ending are especially powerful and the message is one we all have to be reminded of god doesn t talk but he communicates if we would only listen as i am writing this in the midst of the horrors going on in new orleans and the surrounding area due to katrina i was especially moved by the mormons having to leave everything behind and move on after joseph smith was assassinated people came to this country to escape religious persecution and yet they could not the struggle of the mormons to cross the country the cost in lives the hardship they suffered was truly awe inspiring demonstrating their tremendous strength as far as the actual beliefs of mormons this is not heavily gone into and polygamy is mentioned but is not a centerpiece of the film at all the cast is top notch though others who have commented know more about the actual characters and can t talk about how true the portrayals were but as actors dean jagger mary astor brian donlevy john carradine jane darwell all do excellently with the script they were given though the film could have easily stood on its own and certainly does today tyrone power and linda darnell were added to the cast to get the crowds into the movie theaters to see a film about the mormons power is magnificently handsome as a young mormon and darnell as zina is not a mormon but stays on with the family after her father is killed power does not have much to do until the end of the film when he has a big scene and darnell still a teenager at the time of the filming has even less though they make a lovely couple their fate is left unclear regarding her conversion and one does wonder about the polygamy in their case you can t beat either one for eye candy however',

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sion that they had spent a lifetime together both the chris cooper and the ethan hawke segments packed a punch with surprises that seem realistic and similar to experiences that i ve had in the big apple over all the film is a great place to take a date especially if you re already fond of the city itself i can t wait for the next in the cities of love',

'les acteurs' is the absurd story of jean pierre marielle desperately waiting for a cup of hot water the story of a conspiracy against actors the story of aging actors whose careers are slowly less active than they used to be but a stunning tribute to french actors and their cinema supported by a solid reflection about cinema and acting the fourth wall the hidden cameras to play or not to play the story of this film in which most of those famous actors play their own role not to be mixed up with living their life in front of the camera the film is not voyeur is quite vague and follows the actors in series of episodes which make the film quite amusing as andr dussolier quits the film and leaves josiane balasko to play his part great actress she s hilariously serious especially when in dussolier s role she bitches about herself as actors run in each other on the street asking for autographs as fights and gossip happen we recognize pastiche of other scenes in which each or others have played actually for whoever does not know the actors most of them being at least in their s or does not know french cinema this movie has less interest since most of the references will be missed but it will still offer a good track of reflection on aging on acting on public life']

```
In [12]: blackboard.data['rule_based_scores'][:5]
```

```
Out[12]: ['negative', 'positive', 'positive', 'positive', 'positive']
```

```
In [13]: blackboard.data['ml_based_scores'][:5]
```

```
Out[13]: [0, 1, 1, 1, 1]
```

```
In [ ]:
```