# Minesweeper using Knowledge Base

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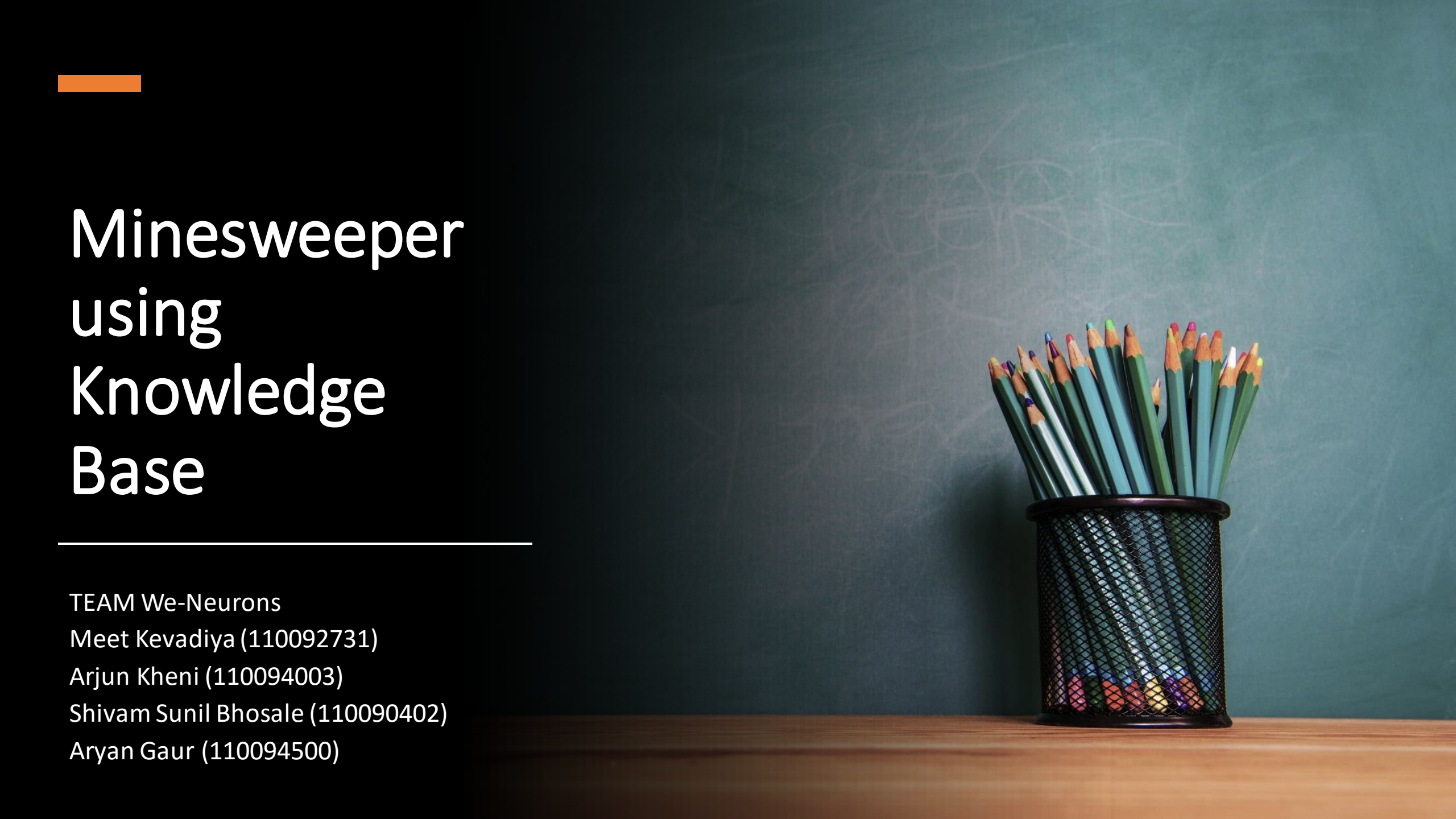
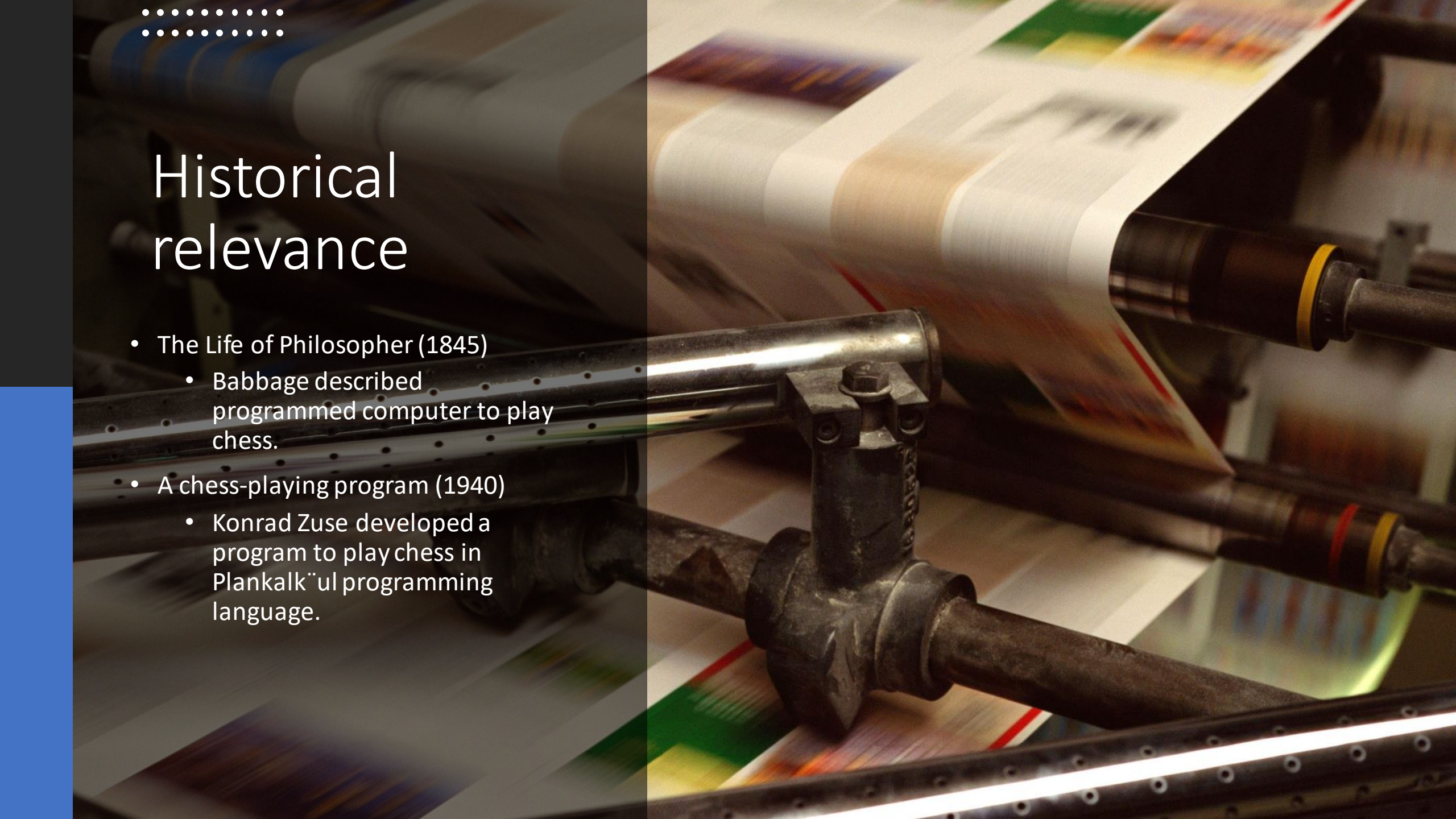


# Problem Definition

- The objective of the project is to build an AI agent to play  the minesweeper game.
- This is done by using Propositional Logic and Inference Rules to determine whether a cell is safe or not.
- During the gameplay, knowledge will we collected after each move and the same knowledge will be used to determine the next move.

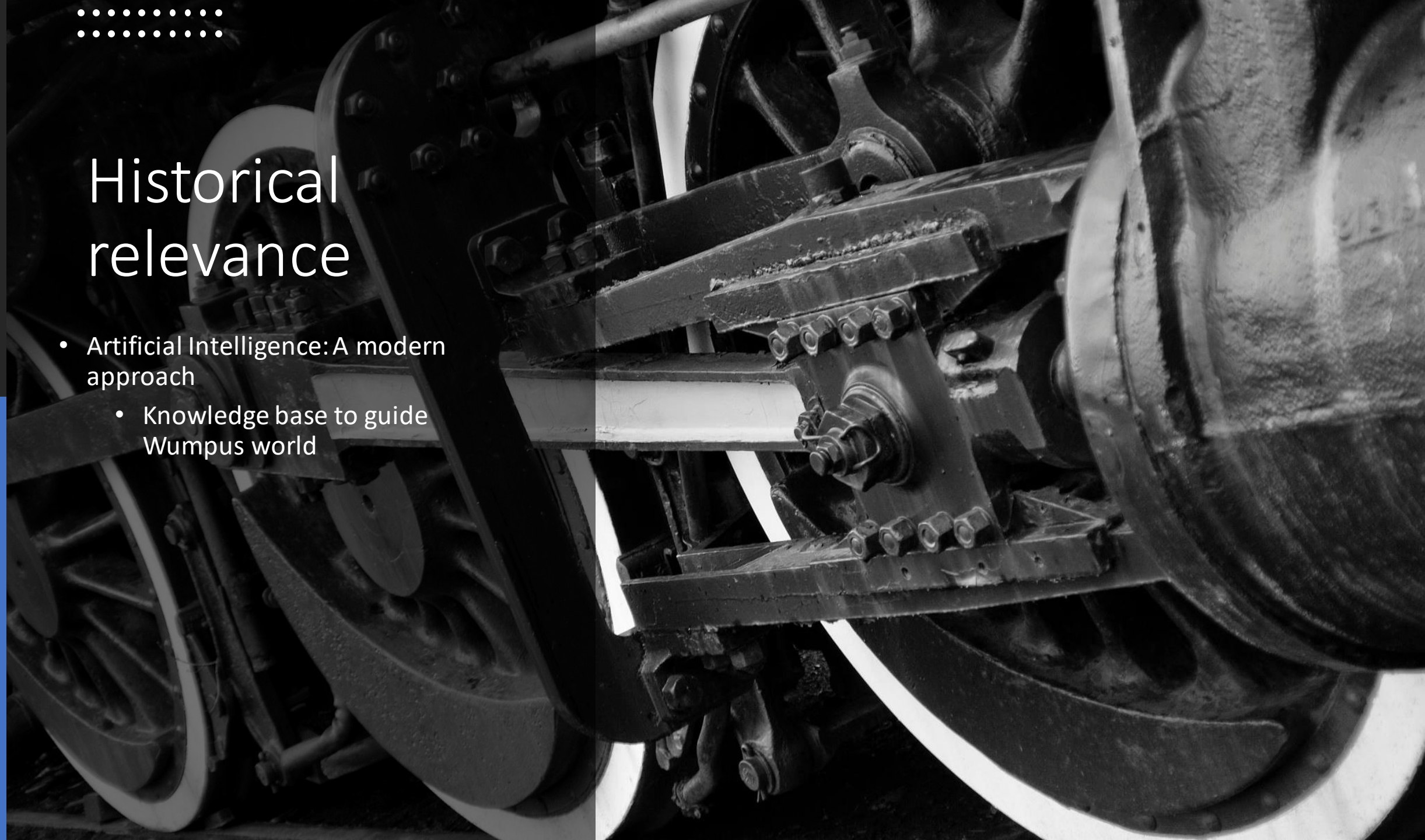
# Historical relevance

- The Life of Philosopher (1845)
  - Babbage described programmed computer to play chess.
- A chess-playing program (1940)
  - Konrad Zuse developed a program to play chess in Plankalk¨ul programming language.



# Historical relevance

- Artificial Intelligence: A modern approach
  - Knowledge base to guide Wumpus world



# Literature Review

Artificial Intelligence in Knowledge-based Technologies and Systems.

Viktor Krasnoproshin, Vladimir Obraztsov, Vladimir Rjazanov, Herman Vissia

This paper drives into the traditional knowledge-based algorithms and proposes modifications in the existing systems ensuring the unification of concepts in artificial intelligence.

Recognition of human front faces using knowledge-based feature extraction and neurofuzzy algorithm.

S.Y Lee, Y.K Ham, RH.Park

The paper talks about a knowledge-based algorithm which could be used for feature extraction. Based on the previous knowledge about human faces five normalised features were extracted, and a Neuro-fuzzy algorithm was used over it to employ the recognition function.

A Propositional Logic-Based Method for Verification of Feature Models

Wei Zhang
**Affiliated with**
Institute of Software, School of Electronics Engineering and Computer Science, Peking University.

This paper propose a proportional logic- based method for verification of feature models at different binding times. With this methodology verification problems like detection of inconsistent constraints can be revealed.

# Literature Review

An Inference Rule for Hypothesis Generation

Robert Demolombe, Luis Farinas del Cerro

This paper depicts inference rule called the L-inference. It was designed in order to derive those clauses and L-strategy. The L-interference rule is a sort of input hyper-resolution. The end result of the paper is the proof of soundness and completeness of the L-interference rule.

DIRT- Discovery of Inference Rules from Text

Dekang Lin, Patrick Pantel

**University of Alberta**

In this paper supervised method for discovering inference rules from text are proposed. The algorithm used in the paper is based on as extended version of Harris' Distributional Hypothesis which states that words that occurred in the same contexts tend to be similar. This is applied to paths in dependency trees of parsec corpus.

# Workflow

Implement

Implement minesweeper game

Create

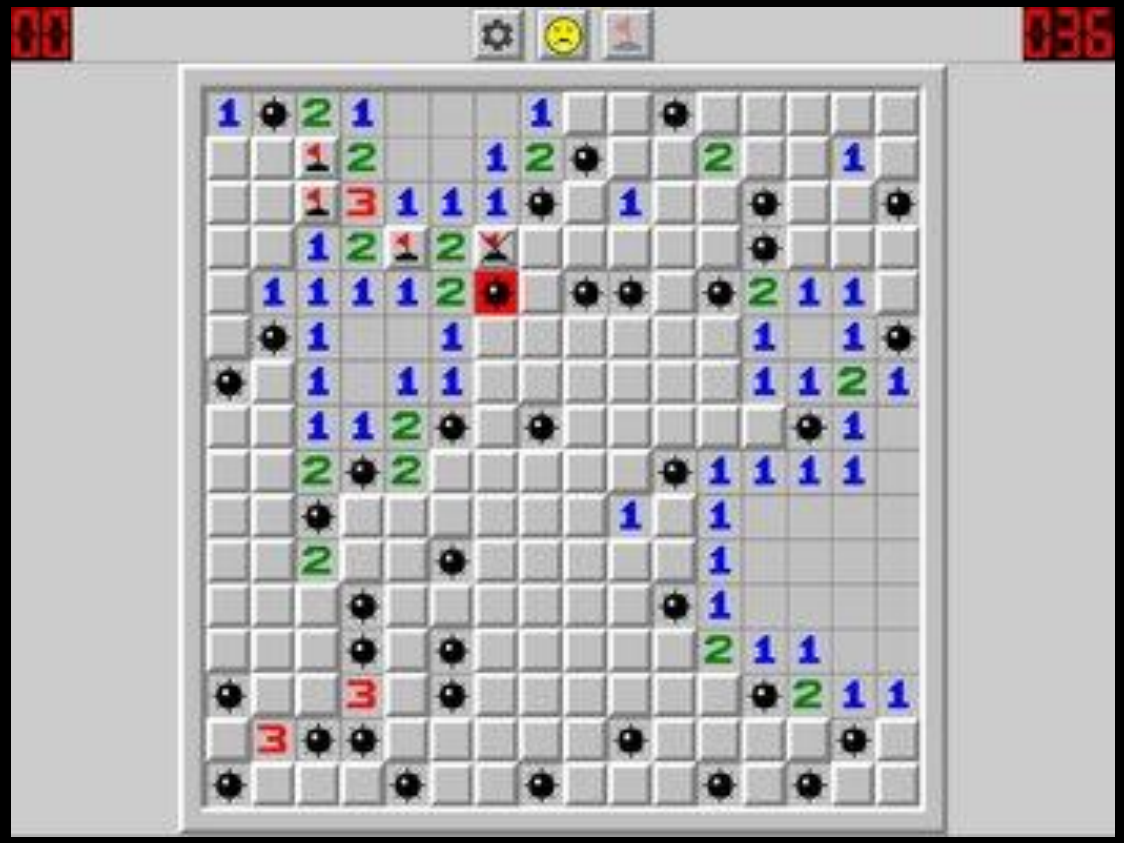
Create an agent

Program

Program the agent

# Minesweeper game

- Has X*Y cells
- Each cell contains a number or mine
- Number denotes number of adjacent cells with mine.
- Player wins if
  - All cells that do not have mine are uncovered
  - No cell with mine is uncovered
  - Cells with mine can be marked with a red flag
- Player looses if they uncover any cell that has mine in it.



# Initialize game window

1. Initialize an array game[] of 8*8 cells as false.
2. Initialize mine as null set
3. Choose a random value i and j range(0, 7)
4. game[i, j] = true
5. mine.append(i,j)
6. Repeat steps 2 to 5 for 8 times

# Propositional Logic and Inference Rule

Propositional logic is a branch of logic that deals with propositions and their relationships to one another. A proposition is a statement that is either true or false, and propositional logic is concerned with how these propositions can be combined and manipulated to form more complex statements.

An inference rule is a logical form that contains function which takes premise, analyses the syntax and produces a conclusion.

# Gameplay

Initially our AI agent will have to make a random move since we don't have any knowledge of the environment . There is a chance that at this stage our AI agent may encounter a mine thereby stopping the gameplay.

Once a first random safe move is made, it will add that move to a move_made knowledge base and the adjacent cells to it will be added into the primary knowledge base along with the safe number associated with it. For example, if the safe number is 2, it means that in the current existing knowledge list there are 2 cells with mines in them.

This procedure will again be repeated and the new knowledge about the adjacent cells and moves made will be added into the knowledge base.

If we get a 0 in one of these moves it means that all the adjacent cells are safe cells and therefore could be added into the safe_moves knowledge base.

This way we could keep playing and making all the safe movements while constantly updating the same knowledge base.

To identify the next safe moves, we can create new sets from the existing knowledge base. Then we can remove cells where we have already made a move by comparing it to the moves_made knowledge base.
Finally, using the inference operation we can compare these sets with one another the resultant will be the position for the next safe move.

# Gameplay

For example,
Let's say we have created two sets from the knowledge base:
Set1:{(6,5),(6,7),(7,7),(6,6),(7,7)}
Set2:{(5,7),(6,5),(7,7),(6,6),(6,7),(7,7)}

Using the inference rule we would get (5,7) as the next safe position for us to make a move.

To identify the mines, we could take the adjacent cell value which has already been revealed of an unopened cell and create a set denoting the neighbours.
For example:

Let's say Set1:{(3,3),(3,4),(3,5),(4,3),(4,5),(5,3),(5,4),(5,5)} = 1, where 1 is the value associated with the adjacent cell. This means that, of all these values in the set there exist a single cell where the mine is located.

Now we could compare this with the moves_made knowledge base to identify the mines. Once the mine is identified it could be added to another knowledge base which has all the values for mines.

This steps could be repeated to identify all the mines.

# Project Status

We are done with the necessary research and have started with development of the project.

The AI agent is also been developed. We need to integrate the same with the GUI  to make it playable in the game.

# Sample Output