UNIVERSIDAD DISTRITAL FRANCISCO JOSÉ DE CALDAS

FACULTAD DE INGENIERÍA

WORKSHOP #1

SYSTEMS ANALYSIS AND DESIGN

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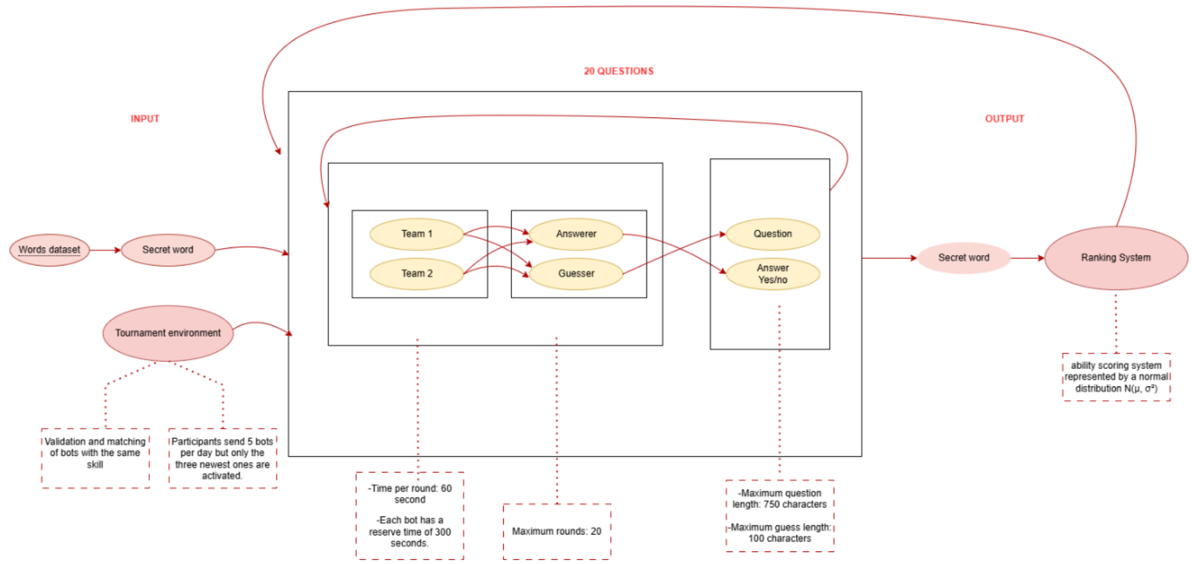
DEVELOPMENT

1. **GENERAL DESCRIPTION OF THE COMPETENCE**
   The Kaggle competition we chose is called "20 Questions", which is a tournament in which linguistic models (LLMs) compete in teams of two (a questioner and a responder) to guess a secret word in up to 20 rounds using dichotomous (yes or no) questions. Each team faces each other in a 2 vs 2 tournament, and the team that guesses the word before the opponent wins; if both teams guess correctly in the same round, a tie is declared. The questioner asks questions (maximum 750 characters) and can make a guess (maximum 100 characters), while the answerer responds only with "yes" or "no". Each round has a limit of 60 seconds per agent, where each bot has an additional 300 seconds of reserve time, in the event that any agent exceeds this time results in the automatic loss of the game. The performance evaluation is based on a skill scoring system represented by a normal distribution $N(\mu, \sigma^2)$, where μ is the estimated skill and σ the uncertainty, which are adjusted according to the results of the games. Each bot is validated by facing itself before joining the system, starting with an initial score of $\mu_0 = 600$. Participants can upload up to 5 agents per day, but only the three most recent remain active and only the one with the highest score appears in the leaderboard. To participate in the competition there are set times such as the closing day to be able to submit bots , a final evaluation and a final ranking. The top five teams will receive cash prizes, with first place being awarded $12,000.
   This competition tests key skills such as deductive reasoning, strategic question formulation, information gathering efficiency and collaboration between agents.

2. **KEY SYSTEM ELEMENTS:**
   - **LLM guesser:** Asks questions and makes guesses.
   - **LLM answerer:** Answers "Yes" or "No" to the guesser's questions.
   - **μ:** Estimated skill value
   - **σ:** Uncertainty in the estimation
   - **Questions:** History of questions asked by the guesser
   - **Answers:** "Yes"/"No" given by the answerer
   - **Secret word**: Proposed word that marks the objective of the game.

3. RELATIONSHIP MAPPING:



The game starts by pairing two bots randomly teams with a similar skill level formed by a questioner and an answerer, the game starts with a maximum of 20 rounds where in each round the questioner of each team generates a question, the respective answerer answers “yes” or “no”, the questioner processes the answer which can lead him to the secret word or to a new more specific question where in each round the system validates the format and times.

If the word is guessed the winner is determined, the ranking system updates µ and σ of the bots involved and the system is fed back with the new skill values.

Restrictions:

- Time per round: 60 seconds
- Total extra time per game: 300 seconds
- Maximum question length: 750 characters
- Maximum guess length: 100 characters
- Maximum rounds per game: 20 rounds
- Maximum number of simultaneously active bots per user: 3 bots

System limits:

Internal limits:

Game logic, participating bots, internal rules.

External limits:

Secret words, Updates or competition settings.

4. **SYSTEMS ENGINEERING PERSPECTIVE:**

System requirements: There must be four participants (two answerers and two guessers), a limit of 20 questions, and the answers must be closed-ended (yes or no). These requirements define the functional framework of the system and establish the input and output conditions. Any alteration in these requirements. For example, allowing open-ended questions would completely change the behavior of the system.

System architecture: There is a sequential flow of question-answer interaction, in which the questioning player acts as the “processor”, interpreting answers and adapting its logic. Each interaction can be seen as a feedback loop, where the mental model about the object is updated. The architecture is modular: each question works as an independent block, but is logically connected to the previous ones.

System life cycle: The game also follows a life cycle similar to that of any software system. It starts with initiation (thinking of an object and defining the rules), continues with iterative execution (questions are asked, answers are interpreted and a decision is made based on accumulated knowledge), and concludes with termination (correct guess or exhausting all 20 questions). This cycle reflects typical processes such as analysis, design, testing and closure.
como análisis, diseño, prueba y cierre.

5. **SYSTEM SENSITIVITY**

To determine the sensitivity of the system involves detecting how variations in the inputs (e.g., the questions asked) can affect the output, such as the performance of the model and the competition.

By doing a deep system analysis it can be observed that the performance of the system is affected by factors such as the following inputs:

- The performance that the bots have in the game directly affects on their skill level and the level of uncertainty
- The way the questions are asked, depending on whether they are asked very general or more targeted, as this affects the number of rounds and the teams that win

- The complexity of the question to be guessed could affect the number of rounds of the game
- According to the rules of the game, bots are randomly paired with another bot of similar skill to face another random pairing. If this system rule is affected there would be an affectation in the competition performance, as there may be high skill teams paired with low skill teams, thus leading to reduce the uncertainty of the system
- Changing the order of question formulation could affect the deductive path to reach the word to be guessed
- system characteristics: homeostasis interconnectedness feedback hierarchy, equifinality permeability equilibrium adaptability self-organization self-regulation

The system adjusts the skill (μ) and uncertainty (σ) of each bot based on the results obtained in each game.

This creates feedback loops where in each game matching is performed based on the skill parameter of each participant.

Each element is connected to each other, each participant depends on each other to form the team where they are related to the questions, answers, the time control of the system and the results of each game.

The stability of the system is maintained in the leaderboard in the long term, this is achieved since it avoids imbalances in the match-ups of the games thanks to the continuous adjustments and input that it has for each bot.

The system allows new bots to enter and adjust gradually giving an initial value of skill and uncertainty, making them participate in games more frequently.

It incorporates the principle of cybernetics through a feedback loop that regulates the performance of the bots. The output of the system, which is the result of each game, becomes an input to the system from the ranking system which adjusts the score of the bots based on their performance. This new ranking affects future pairings, which in turn influences the strategy and behavior of the bots in the following rounds.

6. CHAOS THEORY AND SYSTEM COMPLEXITY

- **Type of questions:** In the game, a poorly formulated question or an answer that is ambiguous, misunderstood or interpreted out of context leads to a chain of incorrect deductions, generating a model of the system that is increasingly distant from reality.

A wrong initial assumption: Thinking that the object must be physical and visible can completely divert the direction of the questions, leading the player to build an incorrect mental model from the beginning, since everything is built wrongly if the assumption was wrong.

Ambiguity and lack of information: Many real systems (as in this game) are analyzed with partial information, leading to decisions with uncertainty. Here, ambiguity as to what options are constrained given the answers can lead to bifurcations in reasoning. This simulates how an analyst may have to make decisions under ambiguity or with not entirely reliable data sources.

Multiple paths to the same outcome: In the game, it is possible to arrive at the correct answer by following different sequences of questions. This multiplicity of paths illustrates the nondeterministic nature of many complex systems, where different configurations can produce similar results, and linearity does not always apply.

Dynamic interaction and continuous adaptation: As new questions are asked and answers are received, players constantly adjust their strategy. This process of adaptation reflects how complex systems do not behave statically, but evolve based on new inputs. In systems analysis, this is similar to how a model must continually be refined based on changing data or new feedback from the environment.

Accumulation of errors or hits: Each answer influences the next questions, and while a correct answer can quickly bring the target closer, an incorrect interpretation can push it further and further away. This accumulation effect reflects how in complex systems, small initial errors or hits can amplify over time, affecting the trajectory of the analysis or the entire system.

7. CONCLUSION

The Kaggle “20 Questions” competition behaves as a complex and adaptive system, where synergy between the questioner and the respondent is essential to achieve optimal performance. Its homeostasis depends on the balance between general and specific questions, while its high sensitivity implies that small errors in the inputs can drastically affect the outputs, just as in chaos theory. Although it has feedback mechanisms that allow course adjustment, its performance can deteriorate if there is a lack of precision in communication and response accuracy. In short, the system is powerful but fragile, and its success depends on precise, resilient and strategically guided collaboration.