- length: at least 3 pages (single-spaced, 12-pt font, 1-in margins)
- content:

1. Project title: Sudoku Solvers
2. Names and email addresses of team members (CSE members first--this is a plan for the CSE contribution)

Michael Richards - mrichards2021@my.fit.edu

Jaden Krekow - jkrekow2021@my.fit.edu

Alice Luce - pluce2021@my.fit.edu

Adrian Rodriguez - adrianrodrig2019@my.fit.edu

3. Faculty advisor: Raghuveer Mohan - rmohan@fit.edu

4. Client: Not Applicable

5. Meeting(s) with the Client for developing this Plan: date(s)

6. Goal and motivation: Discuss the overall goal (help make the intended users "happier") and motivation (why are the intended users not too "happy"? limitations/pains of current systems)

   The goal of this project is to create a functional software that can generate/solve sudoku boards in a user intuitive way. Additionally the software will also provide educational benefits to teach users how to play sudoku as well as teaching users important algorithm information.

   The motivation is to assist in teaching advanced algorithms through the visualization of sudoku solving, as well as to compare the speed and effectiveness of novel solving algorithms.

7. Approach (key features of the system): Discuss at least three key features/functionalities that your system provides for the users to help achieve the overall goal.
   (what features does your system have that can help make the intended users "happier"?)
   (at least one paragraph for each feature, more specific less vague) [e.g. Similar to app descriptions at Google Play, **NOT** the underlying tools]
   For interdisciplinary projects: identify separate CSE features/contributions

a. The user will be able to play sudoku on board with minimal distractions. Users can concentrate on their game with a UI designed to limit the number of distractions around the board. Simple descriptions and easy navigation will help users learn to use the app without much struggle.
b. The user can learn from playing sudoku by using a visualizer that will allow them to choose different algorithms to solve their boards. For any algorithm a user chooses they will be able to view metrics related to that algorithm to see key metrics such as speed.
c. Users will be able to save their current sudoku session and load them. At any point if the board is too hard or they don't have enough time they can always come back to it. The board will be saved and can be loaded even when the current session is closed so no worries about losing the board when the app is closed.
d. The user can ask the system to help solve the board with hints to provide the most helpful information to the current state of the board. These hints will use AI to navigate the user to a cell deemed important for progressing the board. The AI is designed to gradually help the user get better at sudoku before revealing the answer to promote user learning.

8. Algorithms and tools (libraries/api/frameworks/languages) for the key features: Discuss how and which algorithms and tools are used to achieve the features

   Pyside6:

   - Library allows use

   SQLite

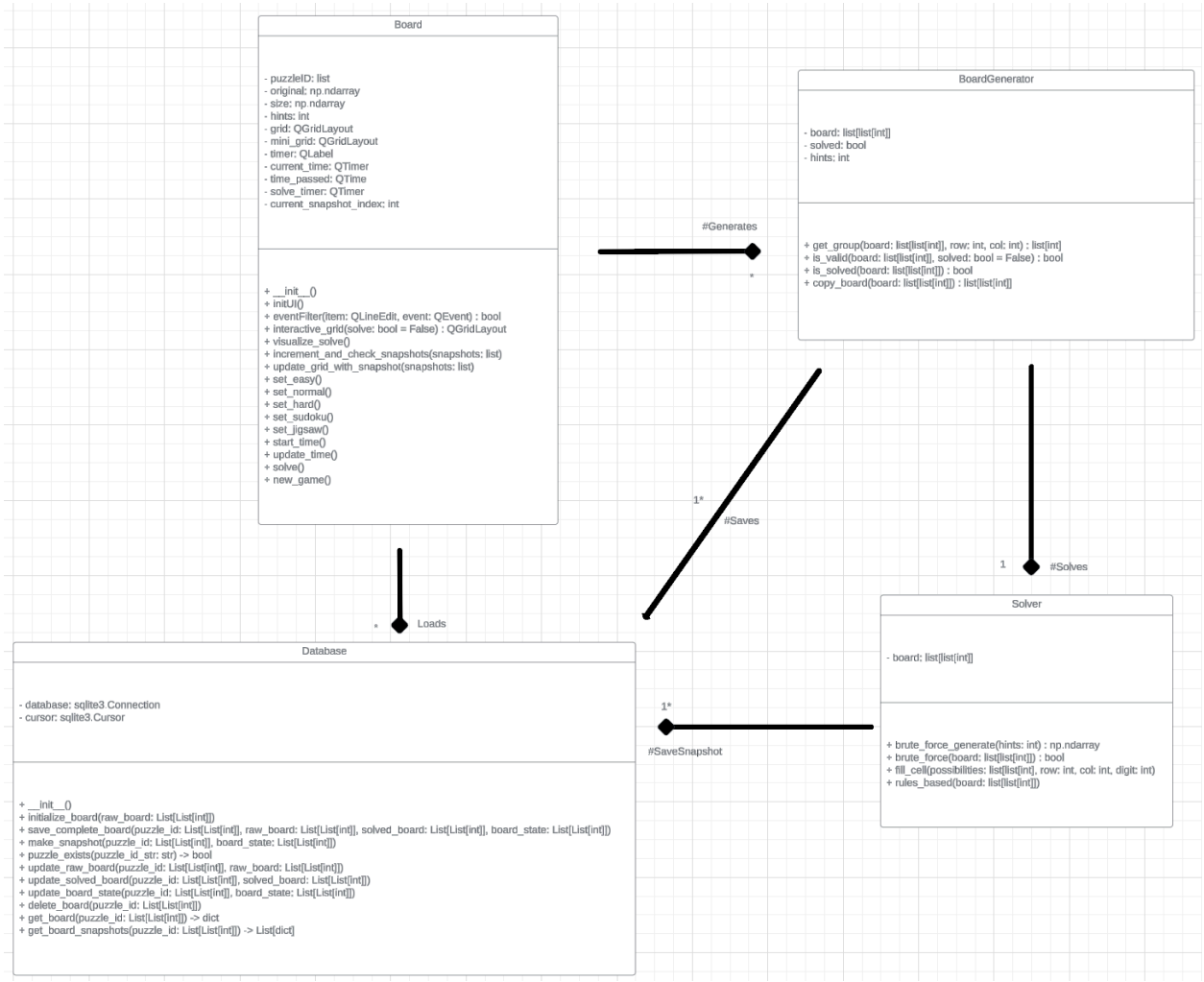
   Rules-Based Search
]https://www.csc.kth.se/utbildning/kandidatexjobb/datateknik/2012/rapport/berggren_patrik_OCH_nilsson_david_K12011.pdf

9. Novel features: Discuss which features/functionalities are novel and why.

   The solver visualizer is novel because it can show how a board is solved by a variety of algorithms and methods, and will be accompanied by additional educational material about the selected solving algorithm, making it an effective and unique educational tool for learning advanced algorithms.

10. Technical Challenges: Discuss three main technical challenges for this semester (for example, "we plan to find the shortest path from A to B, but don't know which algorithm to use.")
    a. Creating experimental algorithms from their descriptions in research papers can be difficult, especially when they do not provide much pseudocode or are uniquely complex in some way.
    b. Updating the UI for better visualization will require integration with the solving algorithms, which can complicate runtime behavior.
    c. Optimizing these algorithms to accurately compare them to each other in terms of runtime complexity and speed is going to take additional time and consideration on top of basic implementation.

11. Design: system architecture diagram



- The Board class creates the GUI and works with the BoardGenerator and Database to implement functionality, such as the auto solver, and update data elements on the board. The BoardGenerator works with the Solver to create partially filled boards to be verified through the Solver, and save solved boards to the Database. The solver saves snapshots into the Database while solving boards to be later used to visualize the solving of the board to the user.
- Board uses PySide6 to create the GUI and Database uses SQLite3.

12. Evaluation: how to measure success? Some ideas:
    - Speed: Test and compare the runtime speed of each solving and generating algorithm
    - user survey: ask questions about the algorithms users visualize solutions with to see if they understood what they visualized or if things need to be clarified.

- Debugging: Trying to find issues with the software so we are able to find issues that are not apparent and fix them earlier rather than later ensuring accuracy and correctness

13. Progress Summary:

Module/feature	Completion %	To do
Algorithms	50%	Two solvers and two generators available. Implement at least two more solvers.
Visualizers	30%	Basic visualization available. Highlighting cells and descriptions of each algorithm required.
Cache	99%	Complete storage, recall, and management of boards. Slight bug with UI interface
GUI	80%	Basic framework is finished, but work needs to be done implementing the menu and database with buttons. Implement the note feature for cells and enhance user interface.

14. Milestone 4 (Feb 24): itemized tasks:
    - Implement, test, and demo which features/modules
    - Bugs fixes, code cleaned up
    - New algorithm implemented
    - Begin Visualization of algorithms
15. Milestone 5 (Mar 26): itemized tasks:
    - Implement, test, and demo which features/modules
    - Implement all algorithms previously chosen
    - Finalize visualization
    - Conduct evaluation and analyze results
    - Create poster for Senior Design Showcase
16. Milestone 6 (Apr 21): itemized tasks:
    - Implement, test, and demo which features/modules
    - Test/demo of the entire system
    - Conduct evaluation and analyze results
    - Create user/developer manual
    - Create demo video

17. Task matrix for Milestone 4 (teams with more than one person)

Task	Alice	Jaden	Adrian	Michael
Database		Bug fix	Fixes issues with database saving/loading and link with GUI and Menu	
Menu	Implementation of descriptions for each algorithm available and planned to implement.		Integrate menu into GUI	
Algorithms	Small bug fixes	Implement new solving algorithm	Research new algorithm and help develop and integrate into software	Implement new solving algorithm
GUI	Groundwork for highlighting cells for algorithm visualization.		Adding Notes features, enhance hint finding, stylize	Bug fix

18. Description (at least a few sentences) of each planned task for Milestone 4:
    - Bug fixes: There are some bugs that got introduced on some of the branches that introduce unintended behaviors or crashes. These

bugs are found in the new rules-based algorithm, the multithreading, and with the database.
    - Prepare UI for more detailed visualization: Develop hooks for algorithms to call to show what is currently being read, modified, and tested. Develop a small window or submenu to describe the processes of each algorithm.
    - Determine and begin development on additional solver algorithms: We would like to implement a new solving algorithm, with the 2 most likely candidates being the dancing links algorithm or the bee colony algorithm.
19. Approval from Faculty Advisor
    - "I have discussed with the team and approve this project plan. I will evaluate the progress and assign a grade for each of the three milestones."
    - Signature: _____ Date: _____