Birzeit University - Faculty of Engineering and Technology
Electrical & Computer Engineering Department - ENCS4330
Real-Time Applications & Embedded Systems - 2^{nd} semester - 2024/2025

Project #3
POSIX threads under Linux
Due: May 25, 2025

Instructor: Dr. Hanna Bullata

Organized crime-fighting simulation

We would like to build a combined multi-processing and multi-threading application that simulates the behavior of infiltrated secret agents in fighting organized crime gangs. The simulation can be explained as follows:

1. Organized crime gangs target the following crime types:
   - Robbing banks and financial institutions,
   - Robbing gold/jewelry shops,
   - Drug trafficking (both buying and selling),
   - Robbing expensive art work,
   - Kidnapping wealthy people and asking for ransoms,
   - Blackmailing wealthy people,
   - Arm trafficking.

2. The number of gangs is user-defined and the number of members in each gang is user-defined as well. However, both belong to user-defined ranges.

   Gangs have user-defined number of rankings within their structures: When a new gang member joins, he/she starts with the lowest rank. With time and devoted service, gang members get promoted to higher ranks. When going to higher ranks, gang members are exposed to more sensitive information about future or potential targets.

3. The gang highest rank picks the next target from the above list and sets the time needed to prepare for it. In addition, it sets the level of preparation that each gang member has to reach before executing their plan.

   When a target is picked, all gang members' initial preparation level is set to 0.

4. To avoid being caught or having their plans exposed to police, gangs spread information among its ranks on on-need basis, meaning as you go down with the ranking, the less you know about the planning of future evil activities. Consider the different factors to be user-defined.

   In addition to the above, the highest gang ranking sometimes spreads false information among the lower gang ranks so as to blur reality and make sure if there are infiltrated secret agents within the gang, they are disoriented about the true new goals. Consider the different factors to be user-defined.

5. The police will try to plant secret agents within gangs (one or more) and the success rate in doing so is user-defined. These secret agents behave like gang members so as not to draw attention and rise in ranking like any other gang member. Usually the secret agents do not know about each other, even within the same gang.

6. The secret agents try to collect information about potential criminal activities from interacting with other gang members from same or lower ranks. Of course they have to do so in a cosy way so as not to rise suspicion about their true objectives. While interacting with lower-rank gang members, secret agents increase their knowledge about future plans: The knowledge rate increases when they get correct information and the knowledge rate decreases when they get false information.

7. At the right time and well preparation, a gang will execute its plan. The success rate is user-defined but should be proportional to the time and preparation made.

8. When secret agents have suspicion beyond user-defined value, they inform the police about the gangs' near-future plans. Else, the secret agents just inform the police about what they have. At this stage, the police will try to confirm the information from other infiltrated secret agents (if any) within the same gang. The police will then act to thwart the gangs' plans if the suspicion rate increases beyond a user-defined threshold by arresting gangs' members for a user-defined period.

9. When their plans are thwarted, gangs suspect that infiltrated secret agents are behind that fact and start an internal investigating about the issue. Of course they start by questioning high-rank gang members since they know more than lower-rank ones. Come up with a strategy that gangs might use to uncover the infiltrated secret agents.

   Once uncovered, secret agents will be executed.

10. When a target is reached by a gang, it starts preparing for the next target. Else, if the plan was thwarted by police, the gang starts preparing for the next target once released from prison (prison period is user-defined). Go back to step **3** above.

11. Gang members might get killed while in mission (percentage is user-defined). In that case, new gang members get hired for the next missions.

12. The simulation ends if any of the following is true:

    - The police has thwarted more than a user-defined number of the gangs' evil plans.
    - The gangs were able to carry out successful evil plans that exceeds a user-defined threshold.
    - The number of uncovered and executed secret agents exceeds a user-defined threshold.

What you should do

- Implement the above problem on your Linux machines using a combined multi-processing and multi-threading approach. Make sure the created processes and threads consume CPU time when needed only.
- Compile and test your program.
- Check that your program is bug-free. Use the `gdb` debugger in case you are having problems during writing the code (and most probably you will :-). In such a case, compile your code using the `-g` option of the `gcc`.
- In order to avoid hard-coding user-defined values or ranges in your programs, think of creating a text file that contains all the values that should be user-defined and give the file name as an argument to the main program. That will spare you from having to change your code permanently and re-compile.
- Use graphics elements from opengl library in order to best illustrate the application. Nothing fancy, just simple and elegant elements are enough.

- Be realistic in the choices that you make!
- Send the zipped folder that contains your source code and your executable before the deadline. If the deadline is reached and you are still having problems with your code, just send it as is!