

**Group Project 02:**  
**RoboWar 5 Battle Robot Coding Competition**  
*[25 Points]*

*Last Updated 3/18/2009  
By Dr. Matthew J. Traum*

***Code Due: Wednesday, May 6, 2009 @ 2:00pm***

***Final Report Due: Monday, May 11, 2009 @ 1:30pm***

***The code portion of this assignment is to be submitted digitally on your MEEN 2250 jump drive.***

***The written portion of this assignment is to be submitted in hard copy format in class.***

***Only one submission of each deliverable per team is required.***  
***Associate all team members' names with the code file and final report.***

**Background**

Mechanical engineers routinely use computer code to control mechanical systems such as assembly line robots and CNC machine tools (as was shown in class). In MEEN 2250, we will use RoboWar 5 to simulate code-controlled robots while assessing students' ability to work in groups, develop an engineered system under realistic constraints, and engage in a competitive engineering design exercise.

RoboWar was born of the desire for a computer experience beyond hand-eye arcade games, and it is predicated on the concept of robots fighting each other without user intervention. The RoboWar programming language is based on Reverse-Polish notation with inspiration from C, Pascal, and assembly code. The language has some similarities to G-Code, which is used to guide CNC machine tools. However, live execution of operators, calculations, and interrupts gives the code additional depth and sophistication beyond CNC tool control.

**Tournament Overview**

Each team will program a Robowar 5 robot for competition in a Mortal Tournament (i.e., a maximum of 9 Hardware Points is allowed), as defined in the program's instructions. Teams are encouraged to name their robots and make unique, representative icons for them. However, artsy add-ons like animations and sounds are totally discouraged and should not be used. These robots are killers, not runway models!

Eight teams will compete in a Mortal Tournament divided into duels and group rounds. Each robot will meet all other robots 100 times in duels, where robots fight one-on-one. In group rounds, randomly selected groups of six robots engage in combat, and each robot meets each other robot at least 100 times. There will be no additional Winners' Circle contest in this tournament. Scores will be tallied based on Mortal Tournament rules. The robot with the highest sum of points from the two stages is declared the winner; the robot with the second highest score gets second place; and so on.

**As an extra incentive for performance, the following extra credit points will be assigned to all team members whose robot places in the top three:**

**First Place: 30 Points (one full grade increase)**

**Second Place: 15 Points (half of one full grade increase)**

**Third Place: 7.5 Points (a quarter of one full grade increase)**

Note that Dr. Traum, Jon Traum (Dr. Traum's younger brother), Dr. Boetcher, and Bora Yuce (the TA) make up one team, and their robot may displace others out of the final three. For example, if the instructors' robot gets first place, no one gets the 30-point first prize.

Significant portions of tournament will be run and shown live on the last regular day of class, Wednesday, May 6 from 2 – 3:20pm. Tournament results will be available for analysis by the end of class on May 6.

### Tournament Scoring

The Mortal Tournament scoring system is summarized as follows:

- Kill Points: 1 point is given to a robot for every other robot that it kills provided that the killing robot hasn't been dead for longer than 20 chronons when the kill takes place. Suicide and crushing the opponent during a collision do not count as kills.
- Survival Points - Individual: in a duel, 1 point is given to each robot alive at the end of the last chronon. If the battle times out, both robots in a duel get survival points.
- Survival Points - Group: in group combat, 3 points is given to each robot that is alive at the end of the battle. If a robot outlives 4 robots but is then killed, it gets 2 survival points. If a robot outlives 3 robots and is then killed, it receives 1 survival point.
- A tie gives the robot the higher score. After 1500 chronons, the battle is declared a double win.

### Specific Tournament Rules

- Laser weapons are allowed, but drones are not. Robots attempting to use drones will be killed by the program at the onset of each battle.
- The "Move and Shoot" restriction is enabled to prevent dominance of "dasher" strategy.
- Robots whose energy reaches -200 will self destruct.
- Total instructions may not exceed 5000.

### Grading

The assignment grade has two components which together total 25 points: 1) the robot code and 2) the final report. A maximum of 10 points will be given based on the robot code, and a maximum of 15 points will be given based on the qualities of the final report.

The following grading rubric items will be applied for the robot code.

- A. Robot compiles with and follows tournament rules. [1 point]
- B. Code demonstrates autonomous ability to avoid crashing into walls. [1 point]
- C. Code demonstrates ability to aim turret and fire projectiles at targets. [1 point]
- D. Code demonstrates use of operators in Reverse-Polish notation to perform calculations. [1 point]
- E. Code effectively uses at least one interrupt to augment robot behavior. [1 point]
- F. Code makes effective use of comment tags to explain operation execution. [1 point]

G. Code possesses at least one coherent battle strategy (which will be detailed in the write-up). [1 point]

H. Code efficiently uses available resources without exceeding boundaries (i.e., all 9 Hardware Points are allocated to hardware, which is used to the greatest extent possible while keeping under the 5000 instruction line maximum). [1 point]

I. Robot ranks among the top 3 duel (solo) scores [1 point]; robot ranks among the middle 3 duel (solo) scores [0.5 points]; robot ranks among the bottom 2 duel (solo) scores. [0 points]

J. Robot ranks among the top 3 group scores [1 point]; robot ranks among the middle 3 group scores [0.5 points]; robot ranks among the bottom 2 group scores. [0 points]

The following grading rubric items will be applied for the final report.

$\alpha$ . Team describes in detail the battle strategy used by their robot, explaining why they feel this approach should be successful. [0 – 3 points]

$\beta$ . Team illuminates how implementation of the code maps onto their battle strategy, describing specifically how the code functions to execute this plan. [0 – 3 points]

$\gamma$ . Based on tournament results, the team fairly assesses how well their battle strategy and code performed compared to competing teams. What aspects of the robot's design worked, what did not work, and why? Did the tournament results come as a surprise? [0 – 3 points]

$\delta$ . The paper describes in detail how working in a group was both an asset and an impediment in this project. What strategies helped the group work well together? What aspects of group work were most difficult to overcome? [0 – 3 points]

$\epsilon$ . The paper is well written; uses college-level English; follows proper technical writing protocols; and applies flawless grammar, spelling, and style in the narrative and figures. [0 – 3 points]

Numerical grading of  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , and  $\epsilon$  will be assessed based on how well items map to the following scale.

3 – Exceptional, 2 – Adequate, 1 – Inadequate, 0 – Nonexistent

***Please include the word count of your essay in the header portion of your report. Reports may not exceed 750 words (roughly three typed, double spaced pages). Reports that do not include a word count or that exceed the 750-word limit will not be graded.***

Notes:

1. Each member of the group will share the same grade on this assignment, and group assignments will not be dropped when calculating students' course grades.

2. Given that most existing robot codes are open source, it is tempting to copy/paste components of existing robot codes to splice together a new robot. Caution! The same plagiarism and academic dishonesty statutes apply to this assignment as any other in MEEN 2250. If a robot behavior idea or a few mundane lines of code are borrowed from a previous robot, please cite the source using a comment embedded in your code. Nonetheless, a majority of the code must be original. The instructor will watch robot behavior and review codes for plagiarism. If evidence of unattributed copying is found, academic sanctions will be applied to the students involved.