Chapter 2

Robo-Raiders Rules

This year's contest is between two "Robo-Raiders". Two pirates have crossed each others' path, and they are looking to get some "Pirate Punch" and treasure. The primary goal is to "pillage" your opponent's ship.

2.1 Objective

Score more points than your opponent by capturing treasure, "drinking" Pirate Punch, or "blasting away" cargo.

2.2 Playing Field

- See Figures 2.1 and 2.2.
- The Robo-Raiders will start on opposite sides of the playing field at one of four random orientations. The machines must fit entirely in the starting circle which is one foot in diameter.
- A 6 inch wide and 2 inch deep gap separates the two "ships" owned by each robot. This gap is the "ocean".
- Each opponent will try to score points in various ways including knocking over the opponents barrels, capturing treasure and attempting to cross to the other ship. The specifics of the scoring system are explained in the scoring section.
- The side walls of the table will be 1.5 inches high, and the ends of the table will have a crossbar which will be 4 inches high, but there will not be an actual wall at these ends.

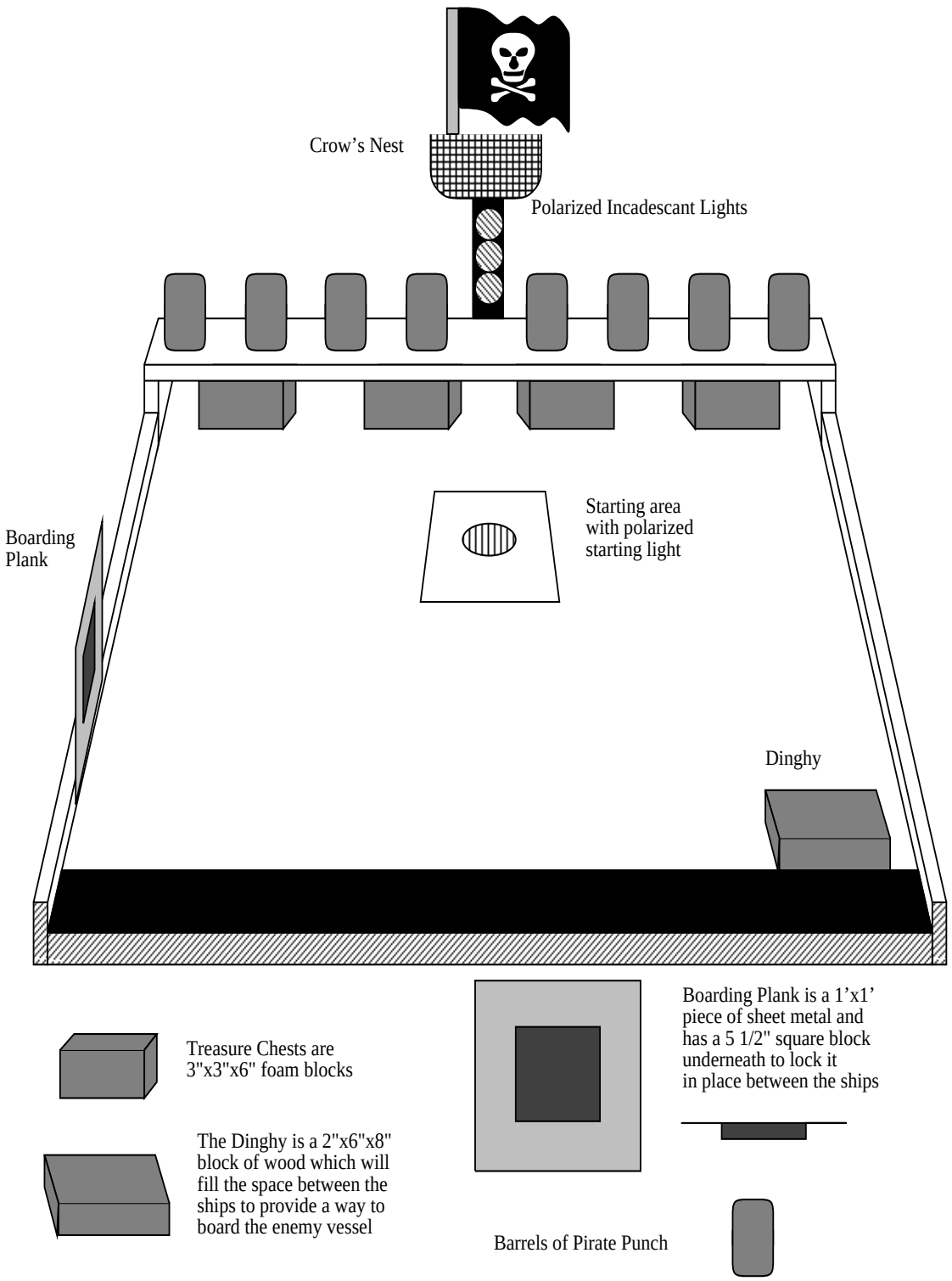

Figure 2.1: 3-D view of "Robo-Raider" Playing Field

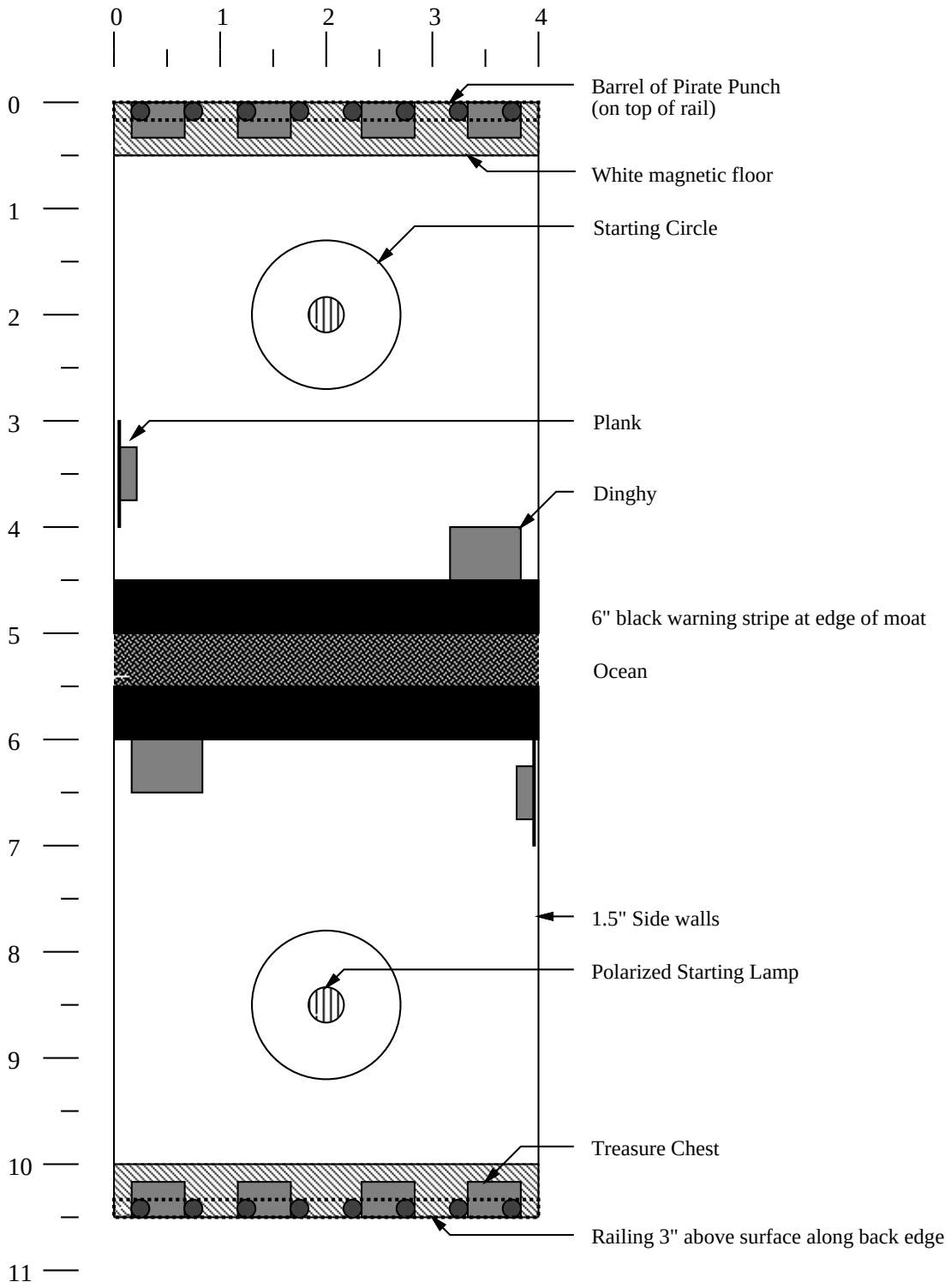

Figure 2.2: Top view of "Robo-Raider" Playing Field

2.2.1 Treasure Chests, Pirates' Punch Barrels and Cannon Balls – Board Setup

- Each team may load up to six cannon balls into the body of their robot at the beginning of the round.
- "Your" chests and barrels are those that are located on the same side of the table as the robot at the beginning of the round.
- The treasure chests will be rectangular foam blocks.
- The dimensions of the blocks will be 3" by 3" by 6".
- There will be 4 chests starting on each side. The chests will be located underneath the ledge at the edge of the table, flush against the end of the table. They can be knocked off the end of the table.
- Robots may gather chests "into" their body (ie, some part of the chest is inside the boundaries of the Lego structure and is not touching the table surface).
- The chests may not be destroyed in any way, such as piercing. They may however be squeezed as long as their shape is not permanently damaged.
- The barrels will be approximately 6" tall and 2" in diameter. They will be located as depicted in the the diagram.
- The barrels may not be damaged.
- A dinghy (one 2" by 6" by 8" wooden block) will be located two inches from the left side of the ships as one faces the opponent's ship. The front edge of the dingy will be even with the black warning stripe.
- A plank (one square foot of sheet metal with a 5.5" square wooden block underneath) will stand on edge at the right edge of the ship six inches ahead of the warning stripe. The plank will be leaning on the wall of the playing surface.
- The back 6" of the ship will have a magnetically encoded white floor.

2.3 Scoring

- Points are awarded for the state of all the barrels, chests and planks and dinghies at the end of the round.

- The term "on the deck of the ship" refers to objects which are in contact with the surface of the table. If the object is overhanging into the water, it will be worth the designated number of points UNLESS it is "in the water" (touching the bottom of the trough between the ships). Any object (with the exception of the dinghy and the plank) are worthless when "in the water" or off the table.
- In the event of a tie in points, declaring the winner(s) will be left to the discretion of the judges. The decision of the judges will be final.
- Points:
  - 1 point for having your dinghy in the water between ships
  - 2 points for having your plank positioned correctly over the water between ships. Correct placement includes having the plank touching the decks of both ships.
  - 1 point for each barrel that is upright on the deck of your ship, or in your robot's body while the robot is on the opponent's ship
  - 2 points for each barrel that is within your robot's body while the robot is on your ship
  - 2 points for treasure chests on the deck of your ship. One additional point if they are within the body of your robot (while the robot is on your ship).
  - 1 point for each treasure chest in your robot's body while the robot is on the opponent's side of the ship

2.4 Period of Play

- The powered portion of a round will last 60 seconds. After the machines are started, they will have 60 seconds to apply battery power to their actuators.
- The round ends when all machines, blocks, barrels and cannon balls come to rest.
- The round will be started by the judges turning on the starting lights, located underneath the table in the center of each robot's starting circle, for the first one second of the round.
- The contestants will place the machines on the playing field within the designated starting circles. A random orientation for the starting of the round will be selected by the judges. Both machines will have the same random orientation. The machines must be placed at that random orientation within the starting area.

- The contestants will have 30 seconds to place their machines on the field from the time the judges call them.

- The contestants must stand a given distance away from the playing field. Any contestants who touches their machine during the round of play will automatically disqualify their robot from the round.

- The machines must have their own internal clock (software will be provided to do this) that cuts off power to the motors at the end of 60 seconds. Any machines that continues to supply actuator power after 60 seconds will be disqualified.

- The contest will be an double elimination competition held over two nights (three sets of rounds). Machines must qualify for the final night of competition, as follows:

  - *Qualifying Rounds.* All machines will play one round (Qualifying Round 1). If a machine loses its round against an opponent, it will run against an inert placebo. If it cannot win against the inert placebo after two tries, it will not qualify for the second round (Qualifying Round 2) of play.
  - *Final Contest.* The main competition. Machines will play until they lose twice. Losses against opponents from the Qualifying rounds are included.

- All rounds will have two robot players.

2.5 Control

- All entries must be solely controlled by their onboard computer. There can be no human intervention once the round begins.

- After the start of the contest, there can be no change to the robot's program or configuration switches made by the contestants.

- No parts or substances may be deliberately dumped, deposited, or otherwise left to remain on the playing surface. A machine that appears to have been designed to perform such a function will be disqualified.

- Machines are not allowed to destroy their opponent's microprocessor board.

- Machines cannot try to destroy other machines' broadcast or detection beacons.

2.6 Infrared Beacon and Light Sources

All robots are required to carry an infrared transmitter. This transmitters acts as a beacon so that robots can locate each other on the playing field. The following rules describe the functionality of the infrared beacon.

- All entries must carry an infrared beacon that is capable of broadcasting infrared (IR) light modulated at either 100 Hertz or 125 Hertz with a 40,000 Hertz carrier (hardware and software is provided to do this).

- Machines failing to meet the infrared transmission specification, or in any way modifying or jamming their transmission frequency during the round of play will be disqualified.

- Judges will assign frequencies for IR emitters to the machines in the beginning of each round by setting the robot's DIP switch 1. If the switch is one, the robot must broadcast 100 Hertz infrared light. If the switch is zero, the robot must broadcast 125 Hertz infrared light. Software will be provided to do this.

- The IR broadcasting beacon must be located at exactly 18" (eighteen inches) above the surface of the playing field when mounted on the robot.

- The beacon must be located so that its center is never more than four inches (measured horizontally) from the geometric center of the microprocessor board.

- The beacon cannot be deliberately obstructed, or be designed in such a way that "accidental" obstructions are probable. This implies that robots may not extend farther than 18" vertically.

2.6.1 Polarized Light Goal Lamps

- Panels that emit polarized light at one of two orientations: a $+45$ degree and -45 degree (with respect to the vertical) polarization will be placed at each end of the playing field.

- The setting of DIP switch 1 will indicate which polarization angle is emitted by the robot's ship. If the switch is one, the robot's ship will be the one with the positive polarization. If the switch is zero, the robot's ship will the the one with negative polarization.

2.6.2 Floor Striping

- The two sides of the playing field will be coded with light or dark visible striping on the lower inside edge of the playing field wall in addition to the color scheme depicted on the diagram.

2.7 Structure

- All kits contain exactly the same components, with the exception of some LEGO parts that may be colored differently in different kits.
- Only LEGO parts and connectors may be used as robot structure. LEGO rubber bands are counted as LEGO parts; therefore, LEGO rubber bands *may* be used to provide structural support to your machine.
- LEGO pieces may not be glued together.
- LEGO pieces may not be altered in any way, with the following exceptions:
  1. The grey LEGO baseplate may be altered freely.
  2. LEGO pieces may be modified to facilitate the mounting of sensors and actuators.
  3. LEGO pieces may be modified to perform a function directly related to the operation of a sensor. An example: Holes may be drilled into a LEGO wheel to help make an optical shaft encoder.
- String may not be used for structural purposes.
- The wooden dowel may be used only as a tower to mount the infrared transmitters and any receivers.
- A non-LEGO part may be attached to at most five LEGO parts via glue.
- A reasonable amount of cardboard, other paper products, and tape may be used for the purpose of creating optical shields for light sensors. The shield may not obstruct IR transmission.
- Wire may only be used for electrical purposes, and not structural.
- Rubber bands may be glued to LEGO wheels or gears to increase the coefficient of friction.
- Only the LEGO rubber bands and thin rubber bands may be used to provide stored energy.

- Contestants may not alter the structure of their entry once the contest has begun, but may repair broken components between rounds if time permits.
- At the start of each round, the dimension of the machine may not exceed an imaginary 1 foot cube. Only the IR transmitting and receiving beacons and the bend sensors may protrude outside this volume. Entries may, however, expand once the round has begun.
- Entries may not drag wires between two or more structurally separate parts of their robot.

  One portion of the robot is considered structurally separate from another if when the machine is lifted from a supporting surface and held from the other portion, the two portions are supported mainly by wire.
- No lubricants may be used.
- Cable ties may not be used for structural purposes.
- Some parts in the 6.270 kit are considered tools and may not be used on the robot. Examples are: the red plastic parts container; the small rectangular parts container; the soldering iron sponge. If there is any question about whether an object is a "kit part" or a "tool part," ask the organizers.
- Any machine that appears to be a safety hazard will be disqualified from the competition.

2.7.1 The $10 Electronics Rule

To encourage creativity, contestants may spend up to $10 of their own funds for the purchase of additional electronic components used in their design. Other than this rule, robots must be designed completely from standard kit parts. The following conditions apply to all non-kit-standard electronic additions:

- The following components, categories of components, or varieties of circuitry are *disallowed:*
  - Batteries of any variety.
  - Motor driver circuitry, including relays, power transistors, or any other replacements or modifications to the standard motor driver circuitry.
  - Microprocessors of any kind.
- Resistors rated less than 1 watt and capacitors valued less than 100 μF may be used freely, without accounting toward the $10 total.

- Contestants who add *any* non-kit parts to their project must turn in a design report that includes: description of the modification, schematic of all added circuitry, and store receipts for parts purchases. This design report must be turned in to the organizers by 5:00 pm, Saturday, January 22, 1992. *Any machines found with added circuitry that has not been documented in this fashion will be disqualified.*

- If a contestant wishes to use an electronic part which has been obtained through other means than retail purchase, an equivalent cost value to the part will be assigned by the organizers. Contestants must obtain this cost estimate *in writing* from the organizers and include it in the design report mentioned above.

  The main reason for this rule is to allow contestants to explore new ways for sensing, and create new sensors.

2.8 Miscellaneous Rules

- In rounds containing a placebo, the contestant's robot must win by at least one point in order to be declared the winner of that round.

- If there is a tie non-zero score of at the end of the round, the decision will be left up to the judges.

- The judges will decide any discrepancies in the contest play.

2.9 Organizers

- Contestants may approach the organizers in privacy to consult about possible designs that may be questionable under the rules listed above. These designs will not be divulged to any of the other contestants. You can send E-mail to 6.270-organizers for any rule clarifications.

- Final arbitration of any rule disputes before the day of the contest (January 23rd) will be decided by the contest organizers.