Midterm exam stats

high score: 100
average = 84.4
low score: 50
Programming Behavior

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In the Second Half of the Semester…

SEARCH(), TRACK(), SEARCHTRACK()
CHASE(), TOUCH(), CHASETTOUCH()

OPTIONS: AIM(), PUNCH(), RETREAT(), BLOCK()

PONG()
Control State Feedback

0: (NO REFERENCE)  the reference stimuli is not detected
1: (TRANSIENT)    stimuli are detected, not converged
2: (CONVERGED)     controller converged to the setpoint

\( \gamma = 0 \) (undefined)
\( = 1 \left( \left| J_c \right| > \varepsilon \right) \)
\( = 2 \left( \left| J_c \right| \sim 0 \right) \)
Multi-Modal State

\[ s = \begin{bmatrix} \gamma_0 & \ldots & \gamma_N \end{bmatrix} \]

actions return \( \gamma \):
\[
\begin{align*}
\gamma &= 0 \text{ (undefined)} \\
&= 1 \text{ (} |J_c| > \varepsilon \text{)} \\
&= 2 \text{ (} |J_c| \sim 0 \text{)}
\end{align*}
\]

unique integer state:
\[
s_3 = g_0(3^0) + g_1(3^1) + \ldots + g_N(3^N)
\]

\[0 \leq s_3 \leq 3^N\]
State-Action Table

```c
/* internal_state=[ 0:SEARCH 1:TRACK ] */

internal_state[0] = SEARCH(roger, time); // assigns values to recommended_setpoints[0]
internal_state[1] = TRACK(roger, time); // assigns values to recommended_setpoints[1]

// for N=2
state = internal_state[1]*3 + internal_state[0];

switch (state) {
    case 0:
        // TRACK          SEARCH
        // NO_REFERENCE - NO_REFERENCE
        \choose action[i] 0 ,= i ,= NATIONS
        \submit_setpoints(recommended_setpoints[i]);
        break;
    case 1:
        // NO_REFERENCE - TRANSIENT
        break;
    case 2:
        // NO_REFERENCE - CONVERGED
        return_state = TRANSIENT;
        break;
    case 3:
        // TRANSIENT   - NO_REFERENCE
        break;
    case 4:
        // TRANSIENT   - TRANSIENT
        break;
    case 5:
        // TRANSIENT   - CONVERGED
        return_state = TRANSIENT;
        break;
    case 6:
        // CONVERGED   - NO_REFERENCE
        break;
    case 7:
        // CONVERGED   - TRANSIENT
        break;
    case 8:
        // CONVERGED   - CONVERGED
        return_state = CONVERGED;
        break;
    default:
        break;
}
```
Rules

points are scored when the balls crossed your goal line

1. Penalties:
   (a) 5 seconds
   (b) touch walls/cross midcourt*
   (c) 20 seconds - point to player w/least possession time
2. first to 11 points wins
3. if Roger blows up (can’t recover) FORFEIT MATCH

*Respect Arena Boundaries - setpoint-filter()
Building Hierarchical Control Code

replicated control structure

primary cortex

secondary cortex

association cortex

visual

auditory

somatosensory

motor

spatially invariant

slow

objects

spatially specific

last

features