De La Salle University
Department of Software Technology

**CCDSTRU Project Specifications**
Term 3, AY 2022–2023
Due: **August 1, 2023 (T) 0800**

Implement a computer program (either in C or Java) following the specifications of the system given below.

## Applicable Sets

- **R** : $\{x \in \mathbf{Z}^+ \mid x \leq 7\}$
- **C** : $\{x \in \mathbf{Z}^+ \mid x \leq 5\}$
- **P** : **R** × **C**

- **S** : $\{(x, y) \in \mathbf{P} \mid x \bmod 2 = y \bmod 2\}$

- **Y** : $\{(x, y) \in \mathbf{S} \mid x \leq 2\}$
- **E** : $\{(x, y) \in \mathbf{S} \mid x \geq 6\}$

- **B** : {true, false}

## System Variables

- $Alpha, Beta, Free \subseteq \mathbf{P}$
- $aTurn \in \mathbf{B}$
- $over \in \mathbf{B}$
- $ok \in \mathbf{B}$

## System Facts

- $Free = \mathbf{P} - (Alpha \cup Beta)$
- $over \leftrightarrow (|Alpha| = 0 \vee |Beta| = 0 \vee Alpha \neq \varnothing \wedge |Alpha - \mathbf{Y}| = 0 \vee Beta \neq \varnothing \wedge |Beta - \mathbf{E}| = 0)$

## System Initialization

- $over$ = false
- $ok$ = false
- $aTurn$ = true
- $Alpha$ = **E**
- $Beta$ = **Y**

## System States and Behavior

**NextPlayerMove**$(prev, next \in \mathbf{P})$

$$(a, b) = prev$$
$$(c, d) = next$$
$$aTurn \wedge prev \in Alpha \wedge a = c + 1 \wedge (d = b \vee d = b + 1 \vee b = d + 1) \rightarrow ok = \neg ok$$
$$\neg aTurn \wedge prev \in Beta \wedge c = a + 1 \wedge (d = b \vee d = b + 1 \vee b = d + 1) \rightarrow ok = \neg ok$$
$$ok \wedge aTurn \wedge next \in Free \rightarrow Alpha = (Alpha - \{prev\}) \cup \{next\} \wedge aTurn = \neg aTurn \wedge ok = \neg ok$$
$$ok \wedge \neg aTurn \wedge next \in Free \rightarrow Beta = (Beta - \{prev\}) \cup \{next\} \wedge aTurn = \neg aTurn \wedge ok = \neg ok$$
$$ok \wedge aTurn \wedge next \in Beta \wedge next \notin \mathbf{S} \rightarrow ok = \neg ok$$
$$ok \wedge aTurn \wedge next \in Beta \wedge next \in \mathbf{S} \rightarrow Beta = Beta - \{next\} \wedge Alpha = (Alpha - \{prev\}) \cup \{next\} \wedge aTurn = \neg aTurn \wedge ok = \neg ok$$
$$ok \wedge \neg aTurn \wedge next \in Alpha \wedge next \notin \mathbf{S} \rightarrow ok = \neg ok$$
$$ok \wedge \neg aTurn \wedge next \in Alpha \wedge next \in \mathbf{S} \rightarrow Alpha = Alpha - \{next\} \wedge Beta = (Beta - \{prev\}) \cup \{next\} \wedge aTurn = \neg aTurn \wedge ok = \neg ok$$

**GameOver**$(over)$

$$result \in \{\text{Beta Wins}, \text{Alpha Wins}\}$$
$$|Beta| = 0 \vee Alpha \neq \varnothing \wedge |Alpha - \mathbf{Y}| = 0 \rightarrow result = \text{Alpha Wins}$$
$$|Alpha| = 0 \vee Beta \neq \varnothing \wedge |Beta - \mathbf{E}| = 0 \rightarrow result = \text{Beta Wins}$$