



CCDSTRU Project Specifications
Term 2, AY 2025–2026
Due: **Mar 30, 2026 (M) before 0800**

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

Applicable Sets

$$\mathbf{C} : \{x \in \mathbf{Z}^+ \mid x < 4\}$$

$$\mathbf{N} : \{x \in \mathbf{Z}^+ \cup \{0\} \mid x \leq 16\}$$

$$\mathbf{M} : \mathbf{C} \times \mathbf{C}$$

$$\mathbf{V} : \{\text{true}, \text{false}\}$$

System Variables

$$good \in \mathbf{V}$$

$$over \in \mathbf{V}$$

$$R, B, S, T, F \subseteq \mathbf{M}$$

$$go \in \mathbf{V}$$

$$found \in \mathbf{V}$$

$$start \in \mathbf{V}$$

$$val \in \mathbf{N}$$

System Facts

$$F = \mathbf{M} - (R \cup B)$$

$$over \leftrightarrow (|F| = 3 \vee val \geq 20 \vee \neg start \wedge (|R| > 0 \wedge |B| = 0 \vee |R| = 0 \wedge |B| > 0))$$

System Initialization

$$good = \text{false}$$

$$found = \text{false}$$

$$B = \emptyset$$

$$go = \text{true}$$

$$val = 0$$

$$S = \emptyset$$

$$start = \text{true}$$

$$R = \emptyset$$

$$T = \emptyset$$

System States and Behavior

Remove($pos \in \mathbf{M}$)

$$go \rightarrow (R = R - \{pos\})$$

$$\neg go \rightarrow (B = B - \{pos\})$$

$$S = S - \{pos\}$$

$$T = T - \{pos\}$$

Replace($pos \in \mathbf{M}$)

$$found = \text{false}$$

$$(go \wedge pos \in B) \rightarrow (B = B - \{pos\} \wedge found = \text{true})$$

$$(go \wedge pos \in R) \rightarrow found = \text{true}$$

$$(go \wedge pos \notin R) \rightarrow (R = R \cup \{pos\})$$

$$(\neg go \wedge pos \in R) \rightarrow (R = R - \{pos\} \wedge found = \text{true})$$

$$(\neg go \wedge pos \in B) \rightarrow found = \text{true}$$

$$(\neg go \wedge pos \notin B) \rightarrow (B = B \cup \{pos\})$$

$$(found \wedge pos \notin S) \rightarrow (S = S \cup \{pos\} \wedge found = \text{false})$$

$$(found \wedge pos \in S \wedge pos \notin T) \rightarrow (T = T \cup \{pos\} \wedge \text{Expand}(pos))$$

Expand($pos \in \mathbf{M}$)

$(a, b) = pos$

$u, d, k, r \in \mathbf{M}$

$u = (a - 1, b)$

$d = (a + 1, b)$

$k = (a, b - 1)$

$r = (a, b + 1)$

Remove(pos)

$(go) \rightarrow \text{Replace}(u)$

$(\neg go) \rightarrow \text{Replace}(d)$

Replace(k)

Replace(r)

Update($pos \in \mathbf{M}$)

$good = \text{false}$

$(pos \notin S) \rightarrow (S = S \cup \{pos\} \wedge good = \neg good)$

$(\neg good \wedge pos \in S \wedge pos \notin T) \rightarrow (T = T \cup \{pos\} \wedge \text{Expand}(pos))$

NextPlayerMove($pos \in \mathbf{M}$)

$(\neg over \wedge start \wedge go) \rightarrow (R = R \cup \{pos\} \wedge S = S \cup \{pos\} \wedge good = \text{true})$

$(\neg over \wedge start \wedge \neg go) \rightarrow (B = B \cup \{pos\} \wedge S = S \cup \{pos\} \wedge good = \text{true})$

$(\neg over \wedge \neg start \wedge (go \wedge pos \in R \vee \neg go \wedge pos \in B)) \rightarrow (\text{Update}(pos) \wedge good = \text{true})$

$(start \wedge |R| = 1 \wedge |B| = 1) \rightarrow start = \text{false}$

$(\neg over \wedge good) \rightarrow (good = \neg good \wedge go = \neg go \wedge val = val + 1)$

GameOver()

$result \in \{\text{"R wins"}, \text{"B wins"}, \text{"draw"}\}$

$(over \wedge |R| > |B|) \rightarrow result = \text{"R wins"}$

$(over \wedge |R| < |B|) \rightarrow result = \text{"B wins"}$

$(over \wedge |R| = |B|) \rightarrow result = \text{"draw"}$