

Formal Language

Purpose

The purpose of this language is where a sequence of events that occur in a basket game is prior to a basket being made or missed. This language must end with a basket being made or missed but allows for multiple attempts.

Intent

There are multiple different events that can occur throughout a basketball game which are the following:

- A player can pass the ball to a player on the same team
- A player can shoot the ball at their basketball hoop
- A player can get the ball stolen from them by a player on the opposing team
- A player can throw the ball out of bounds resulting in an inbound
- A player can foul a player on the opposing team
- A player can call a timeout to the referee
- The referee has the right to accept the timeout or deny it
 - When the timeout is accepted then the ball will be inbounded
 - When the timeout is denied then the game will resume back to its state
- When a player gets fouled then the following can happen:
 - Attempt one or a couple free throw shots
 - Inbound the ball to continue the game
- When a shot is attempted there are two possible outcomes:
 - Made which will be inbounded to the other team or another free throw attempt.
 - Miss can be rebounded by either team, another free throw attempt, or if the ball goes out of bounds due to an air ball then it will be inbounded by

the other team

- When the ball gets inbounded there is a chance that either team can get possession of the ball.

Alphabet

$\Sigma = \{\lambda, h, a, x, y, s, m, n, r, o, t, b, g, f, i\}$ The symbols in the alphabet have the following meaning:

- $x \rightarrow$ This represents the action of passing the ball to a player on the same team
- $y \rightarrow$ This represents a player getting the ball stolen by a player on the opposing team
- $s \rightarrow$ This represents a player shooting the ball
- $r \rightarrow$ This represents a player rebounding the ball
- $o \rightarrow$ This represents a ball going out of bounds
- $i \rightarrow$ This represents the ball getting inbounded
- $m \rightarrow$ This represents the shot attempt being made
- $n \rightarrow$ This represents the shot attempt being missed
- $f \rightarrow$ This represents a foul occurring during the gameplay
- $t \rightarrow$ This represents a timeout being called by a player of the team that has possession of the ball
- $g \rightarrow$ This represents that the timeout was accepted by the referee
- $b \rightarrow$ The represents that the timeout was denied by the referee
- $a \rightarrow$ This represents a player on the home team
- $h \rightarrow$ This represents a player on the away team
- While there is λ transitions when it comes to testing the code it will be denoted as ""

$$Q = \{J, H, A, P_H, P_A, B_H, B_A, M_H, M_A, N_H, N_A, F_H, F_A, R_H, R_A, I_H, I_A\}$$

- $J \rightarrow$ This represents a jump ball which only occurs at the start of every game. This is where the ball is thrown up in the air and which ever team gets the ball has the first possession. This means that J is the start state.
- $H \rightarrow$ This represents the home team.
- $A \rightarrow$ This represents the away team.
- $P_H \rightarrow$ This represents all the player actions that can be taken by the home team.
- $P_A \rightarrow$ This represents all the player actions that can be taken by the away team.
- $B_H \rightarrow$ This represents the basketball hoop assigned to the home team.
- $B_A \rightarrow$ This represents the basketball hoop assigned to the away team.
- $N_H \rightarrow$ This represents the possible actions that can occur if the a player on the home team misses their shot.
- $N_A \rightarrow$ This represents the possible actions that can occur if the a player on the away team misses their shot.
- $M_H \rightarrow$ This represents the possible actions that can occur if the a player on the home team makes their shot.
- $M_A \rightarrow$ This represents the possible actions that can occur if the a player on the away team makes their shot.
- $F_H \rightarrow$ This represents the possible actions taken if a home team player gets fouled by an away team player.
- $F_A \rightarrow$ This represents the possible actions taken if a away team player gets fouled by an home team player.
- $T_H \rightarrow$ This represents the home team calling a timeout
- $T_A \rightarrow$ This represents the away team calling a timeout
- $I_H \rightarrow$ This represents the home team inbounding the ball
- $I_A \rightarrow$ This represents the away team inbounding the ball

For the states the grammar and the machines differ because the grammar gets rid of the M_H, M_A, N_H, N_A states by having their responsibilities in B_H and B_A

Semantics

The purpose of the semantics is to plug in a string of characters to prove if the sequence of basketball plays are valid or invalid. The string must only consist of characters in the Σ . Except λ which is replaced with "" (which is also nothing).

Valid Strings

For a string to be valid the only characters that it must contain are the ones in the Σ but replace λ with "" (a.k.a. just remove λ). Also, for the string to be valid it must follow the transitions of the NFA machine.

- hxhtgiasm
- hsm
- asm
- hsn
- asn
- axayhyaxaxaxaxasnrhtdhxhtgihs
- afihs
- hfsnsnsnrasm

Invalid Strings

- xhsm
- a
- h
- digtah
- hfsnsnsnrasm

Structure

For our structure, we used context-free as our grammar and NFA for our machine. We decided to use context-free because each rule has a non-terminal symbol on the left-hand side and there's a string of terminals and non-terminals. NFA is used for our machine because it has multiple transitions of the possible actions and outcomes in a game scenario including passing, fouls, rebounds, etc.