TML Worksheet

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1 Writing TML Programs

In this section, you will be tested on writing TML programs. Three programs are given below as examples:

- `isDiv2`:

```
// checks whether a binary number is divisible by 2
alphabet = {0, 1}
module isDiv2 {
    while 0, 1 {
        move right
    } if blank {
        move left
        if 0 {
            accept
        } if 1, blank {
            reject
        }
    }
}
```

- `isDiv2Rec`:

```
// checks whether a binary number is divisible by 2 recursively
alphabet = {0, 1}
module isDiv2 {
    if 0, 1 {
        move right
        goto isDiv2
    } if blank {
        move left
        if 0 {
            accept
        } if 1, blank {
            reject
        }
    }
}
```

- aNbN:

```
// checks whether the input is blank or of the form ab, aabb, aaabbb, etc.
alphabet = {a, b}
module aNbN {
    if blank {
        accept
    }
    // cannot start with a b
    if b {
        reject
    } if a {
        changeto blank
        move right
        // go to the end
        while a, b {
            move right
        }
        if blank {
            move left
            // must end with a b
            if a, blank {
                reject
            } if b {
                changeto blank
                move left
                // go to the start and restart
                while a, b {
                    move left
                } if blank {
                    move right
                    goto aNbN
                }
            }
        }
    }
}
```

Following a similar syntax to the code given above, write the following programs. You are free to use the website to check the accuracy of the program while writing the programs.

1. divisibility by 4 in binary iteratively [HINT: Go to the end and check for 2 zeros. Allow 0 as well.]

Solution:

2. palindrome over a, b [HINT: if blank, accept; if single entry, accept; otherwise, remove the first value, go to the end and check that this value is the same. Go to the start and recurse afterwards.]

Solution:

3. divisibility by 4 in binary, recursively.

Solution:

4. check all a's come before the b's.

Solution:

2 Identifying TML Programs

In this section, you are presented with TML programs. You will be given some tape values to run the program in and decode what values the program accepts. You can use the website to try and solve this, but you should attempt executing the program without the website for at least one of the values.

1. Consider the following TML Program:

```
alphabet = {0, 1}
module mystery {
    while 0, 1 {
        move right
    } if blank {
        move left
        if blank, 0 {
            reject
        } if 1 {
            move left
            if blank, 1 {
                reject
            } if 0 {
                accept
            }
        }
    }
}
```

   (a) Does the program accept the values:

      i. $2 = 10$

      Solution:

      ii. $1 = 1$

      Solution:

      iii. $4 = 100$

      Solution:

      iv. $5 = 101$

      Solution:

      v. $6 = 110$

      Solution:

   (b) Describe the values this program accepts.

   Solution:

2. Consider the following TML program:

```
alphabet = {a, b}
module mystery {
    if blank {
        accept
    } if a {
        changeto blank
        move right
        while a, b {
            move right
        } if blank {
            move left
            if a {
                reject
            } if b, blank {
                changeto blank
                move left
                while a, b {
                    move left
                } if blank {
                    move right
                    goto mystery
                }
            }
        }
    } if b {
        changeto blank
        move right
        while a, b {
            move right
        } if blank {
            move left
            if b {
                reject
            } if a, blank {
                changeto blank
                move left
                while a, b {
                    move left
                } if blank {
                    move right
                    goto mystery
                }
            }
        }
    }
}
```

(a) Does the program accept the values:

i. *ab*

Solution:

ii. *aab*

Solution:

iii. *abb*

Solution:

iv. *abba*

Solution:

v. *abab*

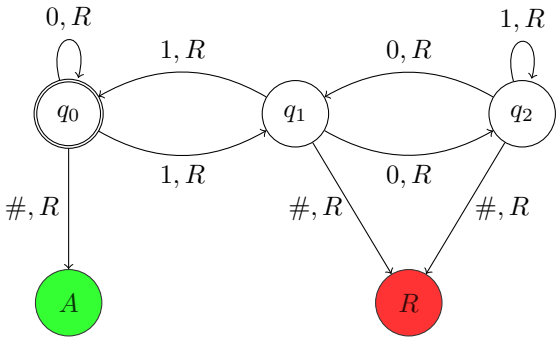
Solution:

(b) Describe the values this program accepts.

Solution:

3 Identifying TMs

1. Consider the following TM FSM:



You are given a basic representation of this FSM as code in Teams.

(a) Does the TM accept the values:

i. $2 = 10$

Solution:

ii. $1 = 1$

Solution:

iii. $6 = 100$

Solution:

iv. $5 = 101$

Solution:

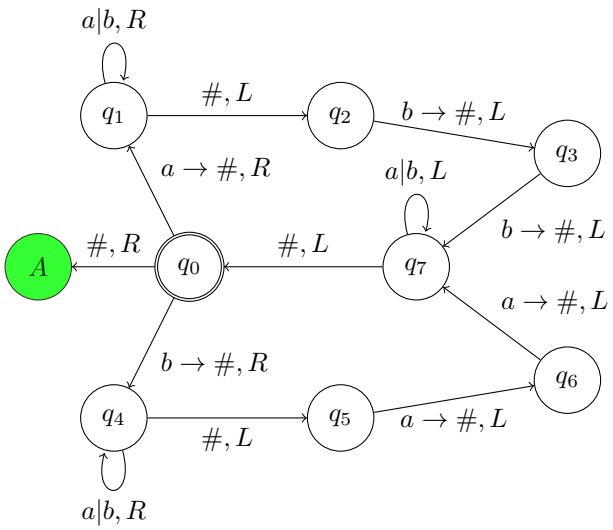
v. $8 = 110$

Solution:

(b) Describe the values this program accepts.

Solution:

2. Consider the following TM FSM:



NOTE: The missing transitions go to the reject state, i.e. q_2, q_3 to $a|\#$ and q_5, q_6 to $b|\#$ are rejected. You are given a basic representation of this FSM as code in Teams.

(a) Does this TM accept the values:

i. *ab*

Solution:

ii. *abb*

Solution:

iii. *aabb*

Solution:

iv. *bbaaaa*

Solution:

v. *abba*

Solution:

vi. *abab*

Solution:

(b) Describe the values this program accepts.

Solution: