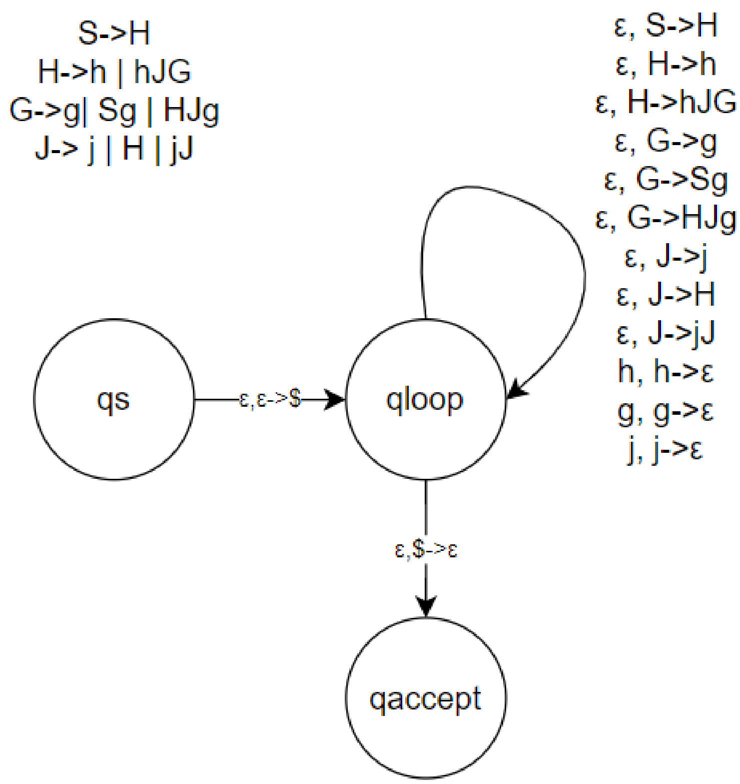
Quiz 2

1. (5) Convert *G* to a PDA using the method described in class

   PDA



2. (10) Convert G to Chomsky Normal Form

   - $S \to H$
   - $H \to h|hJG$
   - $G \to g|Sg|HJg$
   - $J \to h|H|jJ$

   Add S and remove ε:

   $S_0 \to S|\epsilon$
   $H \to h|hJG$
   $G \to g|Sg|HJg$
   $J \to h|H|jJ$

   Remove single rewrites:

   $S_0 \to h|hJG|\epsilon$
   $H \to h|hJG$

$G \rightarrow g|Sg|HJg$
$J \rightarrow h|h|hJG|jJ$

Remove mixed/multiple terminals:

$S_0 \rightarrow S|\epsilon$
$H \rightarrow h|H_0J_1$
$G \rightarrow g|SG_0|H_1G_0$
$J \rightarrow h|H|J_0J$
$H_0 \rightarrow h$
$H_1 \rightarrow HJ$
$G_0 \rightarrow g$
$J_0 \rightarrow j$
$J_1 \rightarrow JG$

Remove long rewrites to get CNF:

$S_0 \rightarrow S|\epsilon$
$H \rightarrow h|H_0JG$
$G \rightarrow g|SG_0|HJG_0$
$J \rightarrow h|H|J_0J$
$H_0 \rightarrow h$
$G_0 \rightarrow g$
$J_0 \rightarrow j$

3. (10) Let $FINITE_{TM}$ = { <M> | *M* is a Turing machine, and *L*(*M*) is finite }. Show that $FINITE_{TM}$ is undecidable.

We know that all finite languages are regular, therefore if we prove that $REGULAR_{TM}$ = { <M> | *M* is a Turing machine, and *L*(*M*) is regular} is undecidable, we know that $FINITE_{TM}$ also has to be undecidable

Proof: Assume BWOC that $REGULAR_{TM}$ is decidable, by definition of decidability let $M_{REGULAR}$ is its decider

Then we build a M_{accept} where:

- We receive Turing machine M and string s
- We mimic A_{TM}
- We construct a new Turing machine $M_{Internal}$ that,
    - Receives string x
    - Accepts if x is in 0^n1^n for some n
    - Otherwise simulates M on s and mimic if M accepts, rejects or fails to halt

Interrogate $M_{Internal}$ for regularity using $M_{REGULAR}$ and accept or reject in agreement. This causes a dichotomy and makes M_{Accept} decide A_{TM} and creates a contradiction, therefore $FINITE_{TM}$ is undecidable