Unsolvable Problems II

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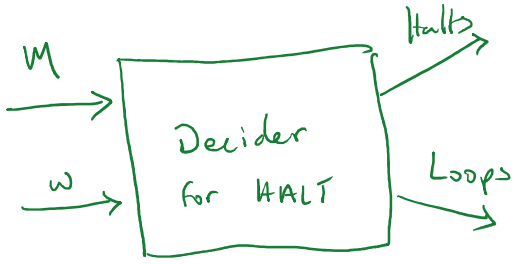
Halting Problem

Q. Given a TM M and string w, will M halt when run on w?

Claim. A decider for HALT is a self-defeating object




```
bool willHalt(string program, int input) {
    // impl
}

int main() {
    string m = mySource();
    string inp = getInput();

    if (willHalt(m, inp)) {
        while (true);
    } else {
        accept()
    }
}
```

Beyond R and RE

$RE = \{ L \mid \exists M.\ \mathcal{L}(M) = L \}$

Since $R \neq RE$ – no general way to "solve" RE problems

RE problems – if convinced $w \in L$, can prove it

Verifiers.

Properties:

V halts on all inputs

$\forall w \in \Sigma^* \leftrightarrow \exists c \in \Sigma^*.$ V accepts $\langle w, c \rangle$

Can build a verifier for RE langs