CMSI 3802: Languages & Automata
Homework 5

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Problem 1

(a) Canadian Postal Codes

```
/^[A-CDEGHJ-NPR-TV-Z]\d[A-CDEGHJ-NPR-TV-Z] \d[A-CDEGHJ-NPR-TV-Z]\d$/
```

(b) Visa

```
/^4(\d{15}|\d{12})$/
```

(c) Mastercard

```
/^(5[1-5]\d{2}|222[1-9]|22[3-9]\d|2[3-6]\d{2}|27[01]\d|2720)\d{12}$/
```

(d) Strings of Unicode letters except those strings that are exactly three letters ending with two Latin letter o's, of any case.

```
/^(?!.o{2}$)\p{L}*$/iu
```

(e) Binary numerals divisible by 16.

```
/^(((?!0{4}$)[01])*0{4}|0+)$/
```

(f) Decimal numerals in the range 8 through 32, inclusive.

```
/^([89]|[12]\d|3[0-2])$/
```

(g) All strings of Unicode letters, except `python`, `pycharm`, or `pyc`.

```
/^(?!py(thon|c?(harm)?)$).*$/u
```

(h) Floating point constants that are allowed to have an empty fractional part, but whose exponent part is required and can have no more than three digits in the exponent part.

```
/^\d+(.\d+)?e[+-]?\d{1,3}$/i
```

(i) Palindromes over the letters a, b, and c, of length 2, 3, 5, or 8

```
/^(?:([abc]?)([abc]?)([abc])[abc]\3\2\1|([abc]?)([abc]?)([abc]?)([abc])\7\6\5\4)$/
```

(j) Python string literals.

Ignore the line breaks, it won't fit on the page without them.

```
/^(?:(?:br|Br|bR|BR|rb|rB|Rb|RB|b|B|r|R|u|U|f|F|fr|Fr|fR|FR|rf|rF|Rf|RF)?
(?:'''(?:\\.|[^\\']|'{1,2}(?!'))*'''
|"""(?:\\.|[^\\"]|"{1,2}(?!"))*"""|'(?:\\.|[^\\\n']|\\'|"(?:\\.|[^\\\n"])*"))$/
```

Problem 2

Show the language $\{\hat{M}_1\{\cdot\}\hat{M}_2 \mid L(M_1) = L(M_2)\}$ is undecidable, using a rigorous reduction argument.

Proof. Let $\kappa = \{\hat{M}_1\{\cdot\}\hat{M}_2 \mid L(M_1) = L(M_2)\}$.
I will demonstrate that if κ is decidable, that would mean that the equality of the Turing machines M_1 and M_2 would have to be decidable, which is not the case.

1. $\not\exists$ a decider, D for κ.
2. To determine if $L(M_1) = L(M_2)$, for any Turing machines M_1 and M_2, we can create the string $\hat{M}_1\{\cdot\}\hat{M}_2$ and pass it to D.
3. If D accepts, then $L(M_1) = L(M_2)$, otherwise $L(M_1) \neq L(M_2)$.
4. Due to the undecidability of the Turing machine equality problem, $\nexists D$ for κ.
5. $\therefore \kappa$ is undecidable.

■