1.) Write the following regular expressions:

   a.) Binary numbers that are multiples of eight

   $$(0|1)^*000$$

   b.) Binary numbers that are an integer power of 2.

   $$0^*10^*$$

   c.) Valid C/Java integer constants that can be negative or positive, in decimal, octal, or hexadecimal.

   The simple but “wrong” way:

   $$([+-]?([1-9]\d*)|(0[0-7]+)|(0[xX][0-9a-fA-F]+))$$

   The “Valid” part requires us to only match numbers in the proper range. It’s impossible for C, since int literals are different depending on the architecture. But for Java and C if we assumed 32-bit, we might do:

   $$0[xX][0-9a-fA-F]\{,8\}$$

   d.) A string literal without escape sequences

   “[^\"]*”

   Your regex engine probably would require escaping some of those in the regex itself.
e.) A block comment without nesting (/\* to */)

\[
\begin{align*}
\text{Star} &= \text{\textbackslash}* \\
\text{CommentStart} &= /\{\text{Star}\} \\
\text{CommentEnd} &= \{\text{Star}\}+ \\
\text{NotAStar} &= [^\ast] \\
\text{Newline} &= [\text{n}] \\
\text{NotAStarOrSlash} &= [^\ast/]
\end{align*}
\]

Ignoring the whitespace in the diagram below, this is what our regex will look like:

\[
\{\text{CommentStart}\}
(\\
  \{\text{NotAStar}\}
  | \{\text{Newline}\}
  | (\\
    \{\text{Star}\}+ \\
    (\\
      \{\text{NotAStarOrSlash}\}
      | \{\text{Newline}\}
    )\\n  )\\n)*
\{\text{CommentEnd}\}
\]

Yields:

\[
/\{[^\ast]\{[n]\}\{[^/\ast]\{[n]\}\})*[^/>\ast]/+
\]

Or JFlex will let you do:

“/\* ~ \*/”

f.) A string of a’s and b’s with an odd number of b’s.

It’s probably easiest to start with a DFA:

From this we can see repetition of a can be anywhere, and that we need one b and then zero or more pairs of b’s to accept. To convert that into a RE:
a*ba*(a*ba*ba*)*

2.) Using the Thompson’s algorithm construction from lecture, convert the following regular expression to an NFA (alphabet is {a,b}):

\[ b?(ab)^*bb^+ \]

As a RE of fundamental operations: \((b|\varepsilon)(ab)^*bb^*\)

3.) Using the Thompson’s algorithm construction from lecture, convert the following regular expression to an NFA (alphabet is {a,b}):

\[ a+bab?a \]

As a RE of fundamental operations: \(aa^*ba(b|\varepsilon)a\)