ECE 653 Assignment 3

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(1):

We want to infer that ,

$$\{n \geq 0 \wedge r = 0 \wedge i = 0 \wedge p = 1\}\ P\ \{r = 2^n - 1\}$$

Where P is the following lines of program

```
while not (i = n) do
{
  r := r - p;
  p := 2 * p;
  r := r + p;
  i := i + 1;
}
```

Given Invariant {I} for the while loop is $p = 2^i \wedge r = 2^i - 1 \wedge i \leq n$

Using rule for while and assignment we can deduce below equation (Given in small font so that equation fits)

$$\frac{\frac{\{p = 2^i \wedge r = 2^i - 1 \wedge i \leq n\} \Longrightarrow \{2p = 2^{i+1} \wedge r + p = 2^{i+1} - 1 \wedge i + 1 \leq n\} \quad \vdash \{2p = 2^{i+1} \wedge r + p = 2^{i+1} - 1 \wedge i + 1 \leq n\} r := r - p \{2p = 2^{i+1} \wedge r + 2p = 2^{i+1} - 1 \wedge i + 1 \leq n\} \quad \vdash \{2p = 2^{i+1} \wedge r + 2p = 2^{i+1} - 1 \wedge i + 1 \leq n\} p := 2 * p \{p = 2^{i+1} \wedge r + p = 2^{i+1} - 1 \wedge i + 1 \leq n\} \quad \vdash \{p = 2^{i+1} \wedge r + p = 2^{i+1} - 1 \wedge i + 1 \leq n\} r := r + p \{p = 2^{i+1} \wedge r = 2^{i+1} - 1 \wedge i + 1 \leq n\} \quad \vdash \{p = 2^{i+1} \wedge r = 2^{i+1} - 1 \wedge i + 1 \leq n\} i := i + 1 \{p = 2^i \wedge r = 2^i - 1 \wedge i \leq n\}}{\vdash \{p = 2^i \wedge r = 2^i - 1 \wedge i \leq n \wedge not(i = n)\}\ r := r - p; p := 2 * p; r := r + p; i := i + 1 \{p = 2^i \wedge r = 2^i - 1 \wedge i \leq n\}}}{\vdash \{p = 2^i \wedge r = 2^i - 1 \wedge i \leq n\}\ while\ not(i = n)\ do\ \{r := r - p; p := 2 * p; r := r + p; i := i + 1;\}\ \{p = 2^i \wedge r = 2^i - 1 \wedge i \leq n \wedge i = n\}}$$

By rule of consequence

$$x = \frac{\vdash\{n \geq 0 \Lambda r = 0 \Lambda i = 0 \Lambda p = 1\} \Longrightarrow \{p = 2^i \Lambda r = 2^i - 1 \Lambda i \leq n\} \quad \vdash\{p = 2^i \Lambda r = 2^i - 1 \Lambda i \leq n \Lambda\, not(i = n)\}\, r := r - p; p := 2 * p; r := r + p; i := i + 1 \{p = 2^i \Lambda r = 2^i - 1 \Lambda i \leq n\} \quad \vdash\{p = 2^i \Lambda r = 2^i - 1 \Lambda i \leq n \Lambda i = n\} \Longrightarrow \{r = 2^n - 1\}}{\vdash\{n \geq 0 \Lambda r = 0 \Lambda i = 0 \Lambda p = 1\}\, while\ not(i = n)\ do\ \{r := r - p; p := 2 * p; r := r + p; i := i + 1; \}\, \{r = 2^n - 1\}}$$

4(C):

In sym.py the main() method cannot be invoked from others ,so main() and its linked _parse_args() cannot be covered using test_sym.py