Introduction to Programming

N.R.Aravind

I.I.T. Hyderabad

Topics for review

- while loop examples
- Binary numbers, bitwise operators and hexadecimal
- Taylor series

Syntax

```
while (condition)
{
// Some statements
}
```

Useful basic block

```
i=1;
while(i<=100)
{
// Some statements
i=i+1;
}
```

Binary Arithmetic

Decimal

- $4716 = 4 \times 10^3 + 7 \times 10^2 + 1 \times 10^1 + 6 \times 10^0$.
- 4716=6+10+700+4000
- 583=3+80+500
- Decimal: Multiply by 1, 10, 100, 1000 etc. (right-to-left)
- In binary, we multiply by 1, 2, 4, 8 etc. (right-to-left)

Binary

- Multiply by 1, 2, 4, 8 etc. (right-to-left)
- $(1101)_2 = 1 + 4 + 8 = 13$.

Binary

- Multiply by 1, 2, 4, 8 etc. (right-to-left)
- $(1101)_2 = 1 + 4 + 8 = 13.$
- $(1101)_2 = 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0.$
- In binary, $(100)_2 = 4$ and $(111)_2 = 7$.

Binary to decimal

- $101_2 =$

Binary to decimal

- $101_2 = 5$.

Binary to decimal

- $101_2 = 5$.
- $1000_2 =$

Binary to decimal

- $101_2 = 5$.
- $1000_2 = 8$.

Binary to decimal

- $101_2 = 5$.
- $1000_2 = 8$.
- $1110_2 =$

Binary to decimal

- $101_2 = 5$.
- $1000_2 = 8$.
- $1110_2 = 14$.

Binary to decimal

- $101_2 =$ 5.
- $1000_2 =$ 8.
- $1110_2 =$ 14.
- $10101_2 =$

Binary to decimal

- $101_2 = 5$.
- $1000_2 = 8$.
- $1110_2 = 14$.
- $10101_2 = 21$.

Digits: right-to-left

- $4716 = 10 \times 471 + 6$
- $471 = 10 \times 47 + 1$
- $47 = 10 \times 4 + 7$
- $4 = 10 \times 0 + 4$.

Digits: right-to-left

- $4716 = 10 \times 471 + 6$
- $471 = 10 \times 47 + 1$
- $47 = 10 \times 4 + 7$
- $4 = 10 \times 0 + 4$.

- $14 = 2 \times 7 + 0$
- $7 = 2 \times 3 + 1$
- $3 = 2 \times 1 + 1$
- $1 = 2 \times 0 + 1$.

$14 = (1110)_2$.

Binary operators

- $15 = (1111)_2$, $20 = (10100)_2$, $127 = 1111111$

Binary operators

- $15 = (1111)_2$, $20 = (10100)_2$, $127 = 1111111$
- AND: $1\&1 = 1$ $0\&0 = 0\&1 = 1\&0 = 0$.
- $15\&20 = (00100)_2 = 4$.

Binary operators

- $15 = (1111)_2$, $20 = (10100)_2$, $127 = 1111111$
- AND: $1\&1 = 1$ $0\&0 = 0\&1 = 1\&0 = 0$.
- $15\&20 = (00100)_2 = 4$.
- OR: $1|0 = 0|1 = 1|1 = 1$, $0|0 = 0$.
- $15|20 = (11111)_2 = 31$.

Binary operators

- $15 = (1111)_2$, $20 = (10100)_2$, $127 = 1111111$
- AND: $1\&1 = 1$ $0\&0 = 0\&1 = 1\&0 = 0$.
- $15\&20 = (00100)_2 = 4$.
- OR: $1|0 = 0|1 = 1|1 = 1$, $0|0 = 0$.
- $15|20 = (11111)_2 = 31$.
- Shift operators
- $(15 << 2) = (111100)_2 = 60$.

Binary operators

- $15 = (1111)_2$, $20 = (10100)_2$, $127 = 1111111$
- AND: $1\&1 = 1$ $0\&0 = 0\&1 = 1\&0 = 0$.
- $15\&20 = (00100)_2 = 4$.
- OR: $1|0 = 0|1 = 1|1 = 1$, $0|0 = 0$.
- $15|20 = (11111)_2 = 31$.
- Shift operators
- $(15 << 2) = (111100)_2 = 60$.
- $(15 >> 2) = (11)_2 = 3$.

Binary operators

- $21 = (10101)_2$
- $21\&1 = 1$
- $21\&2 = 0$
- $21\&4 = 4$
- $21\&8 = 0$
- $21\&16 = 16$

Hexadecimal

- 0,1,2,. . . ,9,a,b,c,d,e,f
- $(2a3)_{16} = 2 \times 256 + 10 \times 16 + 3 = 675.$

Hexadecimal

- 0,1,2,. . . ,9,a,b,c,d,e,f
- $(2a3)_{16} = 2 \times 256 + 10 \times 16 + 3 = 675.$
- int a=0x2a3;

Hexadecimal

- 0,1,2,. . . ,9,a,b,c,d,e,f
- $(2a3)_{16} = 2 \times 256 + 10 \times 16 + 3 = 675.$
- int a=0x2a3;
- printf("%d",a);
- 675 is printed.

Hexadecimal

- 0,1,2,. . . ,9,a,b,c,d,e,f
- $(2a3)_{16} = 2 \times 256 + 10 \times 16 + 3 = 675.$
- int a=0x2a3;
- printf("%d",a);
- 675 is printed.
- int a=31;
- printf("%x",a);
- 1f is printed.

Taylor series

- $\dfrac{1}{1-r} = 1 + r + r^2 + r^3 + \ldots$.
- $\dfrac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots$.
- Let $f(x) = \dfrac{1}{1-x}$.

Taylor series

- $\dfrac{1}{1-r} = 1 + r + r^2 + r^3 + \ldots$.
- $\dfrac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots$.
- Let $f(x) = \dfrac{1}{1-x}$.
- $f(0.1) = 1.111111\ldots.$

Taylor series

- $\dfrac{1}{1-r} = 1 + r + r^2 + r^3 + \dots.$
- $\dfrac{1}{1-x} = 1 + x + x^2 + x^3 + \dots.$
- Let $f(x) = \dfrac{1}{1-x}$.
- $f(0.1) = 1.111111....$
- $1 + 0.1 + 0.01 + 0.001 = 1.111.$

Taylor series

- $e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$.
- $\log(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \dots$.

$$f(x) = \sum_{i=0}^{\infty} a_i x^i,$$

where $a_i = \frac{f^{(i)}(0)}{i!}$.

Taylor series

- Calculate the ith term in the ith iteration.
- Calculate each term from the previous one.
- Maintain the running total.