notes

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Contents

1 Basic Algorithm

1.1 Algorithm

1.1.1 Euclid Algorithm

Given 2 number m and n, request for their bcommon divisor

1. set r=m%n
2. if r=0 Done return n
3. if r!=0 $m \leftarrow n$, $n \leftarrow r$, return E1

1. Code

```
//Eculid.h
int Euclid(int m,int n){
  int r=m%n;
  while(r!=0){
```

```
    m=n;
    n=r;
    r=m%n;
  }
  return n;
}
// Euclid.cpp
#include<iostream>
#include "Euclid.h"
using namespace std;
int main()
{
    int m,n;
    cout<<"input 2 number"<<endl;
    cin>>m>>n;
    cout<<"run the function"<<endl;
    cout<<Euclid(m,n)<<endl;
    return 0;
}
```

1.1.2 A Variant of Euclid Algorithm

1. if $m \geq n$, exchange m,n ($m \leftrightarrow n$)
2. set r=m%n
3. if r=0 Done return n
4. if r!=0 $m \leftarrow n$, $n \leftarrow r$, return E2

1. Code

```
//Functional file
int Variant_Euclid(int m,int n){
  if(m>n){
    int tmp=n;
    n=m;
    m=tmp;
  }
  int r=m%n;
  while(r!=0){
```

```
        m=n;
        n=r;
        r=m%n;
      }
      return n;
    }
    //Interface
    #include<iostream>
    #include "Variant_Euclid.h"

    using std::cin;
    using std::cout;
    using std::endl;
    int main()
    {
        cout<<"Please input 2 number"<<endl;
        int m,n;
        cin>>m>>n;
        cout<<Variant_Euclid(m,n)<<endl;
        return 0;
    }
```

1.1.3 Exercise

- 1

$t \leftarrow a$, $a \leftarrow b$, $b \leftarrow c$, $c \leftarrow d$, $a \leftarrow t$.

- 2. prove that after step 2, $m > n$

solution
In step one, $r = m\%n$, if $r \neq 0$ (r<n), then $m \leftarrow n$, $n \leftarrow r$, so $m > n$

- 4.

Solution
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- 5.

Finiteness: the reader can work on exercices and check answers indefinitely
Output: the procedure have no output
Effectiveness: relaxing and sleeping are not effective operations

- 6.

N0 = 1; N1 = 2; N2 = 3; N3 = 4; N4 = 3;
T5 = (1+2+3+4+3)/5 = 13/5 = 2.6
If k < 5, the first iteration just permutes the values of m and n.
And if k >= 5, the first iteration is a division of k by 5.
So the number of steps is the same for each class modulo 5 of integers.

- 7.

$U_n = T_{n+1}$

1.2 Mathematical Foundation

1.2.1 Mathematical Induction(MI)

1. $P(1)$ is true.
2. if $P(2), P(3), \cdots, P(n)$ is true then $P(n+1)$ is True.

1.2.2 Example

$$1 + 3 + 5 + 7 + 9 = 5^2 \tag{1}$$

then

$$1 + 3 + \cdots + (2n-1) = n^2 \tag{2}$$

Call this equation $P(n)$

---

1. $\because$ 1=1^2 so P(1) is True
2. if P(1),P(2),P(3),$\cdots$,P(n) is True, especially P(n) is True then Eq. (2), add (2n+1) on both sides of the equation:

$$1 + 3 + \cdots + (2n-1) + (2n+1) = n^2 + 2n + 1 = (n+1)^2$$

we get P(n+1) is True.
