算法结构

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| 顺序结构 | | |
| 选择结构 | | |
| ┗ |  | |
|  | ┣ | “单分支”选择结构 |
|  | ┣ | “双分支”选择结构 |
|  | ┗ | “多分支”选择结构 |
| 循环结构 | | |
| ┣ |  | |
| ┃ | ┣ | 当型循环结构（入口条件循环） |
| ┃ | ┗ | 直到型循环结构（退出条件循环） |
| ┗ |  | |
|  | ┣ | 不确定循环 |
|  | ┗ | 计数循环 |

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查找

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| 顺序查找 |
| 二分查找 |
| 分块查找 |
| 哈希查找 |

排序

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| void print\_indent(int indent=0)  {  int i;  for(i=0;i!=indent;++i)  {  printf(" ");  }  }  void print\_array(int\*p,int n,int highlight1=-1,int highlight2=-1)  {  int i;  for(i=0;i!=n;++i)  {  if(i==highlight1||i==highlight2)  {  printf("[%d]",p[i]);  }  else  {  printf(" %d ",p[i]);  }  }  }  void print\_heap(int\*p,int n,int highlight1=-1,int highlight2=-1,int indent=0)  {  int i1,i2;  print\_indent(indent);printf("/\n");  for(i1=1;i1<=n;i1\*=2)  {  print\_indent(indent);printf("|");print\_indent(i1\*2-2);  for(i2=0;i2!=i1&&i1-1+i2<n;++i2)  {  if(i1-1+i2==highlight1||i1-1+i2==highlight2)  {  printf("[%d]",p[i1-1+i2]);  }  else  {  printf(" %d ",p[i1-1+i2]);  }  }  printf("\n");  }  print\_indent(indent);printf("\\");  }  void sort(){}  int main()  {  int i,max=20;  const int n=10;  int a[n];  srand(static\_cast<unsigned int>(time(NULL)));  for(i=0;i!=n;++i)  {  a[i]=rand()%max;  }  print\_array(a,n);printf("\n");  sort();  print\_array(a,n);printf("\n");  } |

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| 插入排序   |  | | --- | | 直接插入排序  / | | 折半插入排序  二分查找  int insert\_position(int\*p,int n,int key)  {  int min=0,mid,max=n-1;  while(min<=max)  {  mid=(min+max)/2;  if(p[mid]==key)  {  return mid;  }  if(p[mid]>key)  {  max=mid-1;  }  else  {  min=mid+1;  }  }  mid=(min+max)/2;  if(p[mid]<key)  {  return mid+1;  }  else  {  return mid;  }  }  void sort(int\*p,int n)  {  int i,j,pos,temp\_swap;  for(i=1;i!=n;++i)  {  pos=insert\_position(p,i,p[i]);  printf("(i=%d)",i);print\_array(p,n,i,pos);printf("\n");  temp\_swap=p[i];  for(j=i;j!=pos;--j)  {  p[j]=p[j-1];  }  p[pos]=temp\_swap;  printf ("(i=%d)",i);print\_array(p,i+1,pos);printf("\n");  }  } | | 希尔排序 | |
| 交换排序   |  | | --- | | 冒泡排序  void sort(int\*p,int n)  {  int i,flag=n-1,next\_flag;//i:[0,flag)  int temp;  while(flag!=0)  {  next\_flag=0;  printf("flag=%d\n",flag);  for(i=0;i!=flag;++i)  {  if(p[i]>p[i+1])  {  printf("(i=%d)",i);print\_array(p,flag+1,i,i+1);printf ("\n");  temp=p[i];p[i]=p[i+1];p[i+1]=temp;  printf("(i=%d)",i);print\_array(p,flag+1,i,i+1);printf ("\n");  next\_flag=i;  }  }  flag=next\_flag;  printf("flag=%d\n",flag);  printf("\n");  }  } | | 快速排序  分治法  void split(int\*p,int n,int\*i1,int\*i2,int indent=0)重复元素少  {  print\_indent(indent);printf("/\n");  print\_indent(indent);printf("|");print\_array(p,n,n-1);printf("\n");  \*i2=0; \*i1=n-2;  print\_indent(indent);printf("|");printf("(i2=%d i1=%d)\n",\*i2,\*i1);  int temp\_swap;  while(1)  {  while(\*i2!=n-1&&p[\*i2]<=p[n-1])  {  ++\*i2;  }  while(\*i1!=-1&&p[\*i1]>=p[n-1])  {  --\*i1;  }  if(\*i2>=\*i1)break;  print\_indent(indent);printf("|/");print\_array(p,n,\*i2,\*i1);printf("(i2=%d i1=%d)\n",\*i2,\*i1);  temp\_swap=p[\*i2]; p[\*i2]=p[\*i1]; p[\*i1]=temp\_swap; ++\*i2; --\*i1;  print\_indent(indent);printf("|\\");print\_array(p,n,\*i2,\*i1);printf("(i2=%d i1=%d)\n",\*i2,\*i1);  }  print\_indent(indent);printf("|/");print\_array(p,n,\*i2,\*i1);printf("(i2=%d i1=%d)\n",\*i2,\*i1);  temp\_swap=p[\*i2]; p[\*i2]=p[n-1]; p[n-1]=temp\_swap; ++\*i2;  print\_indent(indent);printf("|\\");print\_array(p,n,\*i2,\*i1);printf("(i2=%d)\n",\*i2);  print\_indent(indent);printf("\\\n");  }  void split(int\*p,int n,int\*i1,int\*i2,int indent=0)重复元素多  {  print\_indent(indent);printf("/\n");  print\_indent(indent);printf("|");print\_array(p,n,n-1);printf("\n");  \*i2=0; \*i1=n-2;  print\_indent(indent);printf("|");printf("(i2=%d i1=%d)\n",\*i2,\*i1);  int temp\_swap,i\_temp;  while(1)  {  while(\*i2!=n-1&&p[\*i2]<=p[n-1])  {  ++\*i2;  }  while(\*i1!=-1&&p[\*i1]>p[n-1])  {  --\*i1;  }  if(\*i2>=\*i1)break;  print\_indent(indent);printf("|/");print\_array(p,n,\*i2,\*i1);printf("(i2=%d i1=%d)\n",\*i2,\*i1);  temp\_swap=p[\*i2]; p[\*i2]=p[\*i1]; p[\*i1]=temp\_swap; ++\*i2; --\*i1;  print\_indent(indent);printf("|\\");print\_array(p,n,\*i2,\*i1);printf("(i2=%d i1=%d)\n",\*i2,\*i1);  }  i\_temp=0;  while(1)  {  while(i\_temp!=\*i2&&p[i\_temp]<p[n-1])  {  ++i\_temp;  }  while(\*i1!=-1&&p[\*i1]==p[n-1])  {  --\*i1;  }  if(i\_temp>=\*i1)break;  print\_indent(indent);printf("|/");print\_array(p,n,i\_temp,\*i1);printf("(i\_temp=%d i1=%d)\n",i\_temp,\*i1);  temp\_swap=p[i\_temp]; p[i\_temp]=p[\*i1]; p[\*i1]=temp\_swap; ++i\_temp; --\*i1;  print\_indent(indent);printf("|\\");print\_array(p,n,i\_temp,\*i1);printf("(i\_temp=%d i1=%d)\n",i\_temp,\*i1);  }  print\_indent(indent);printf("|/");print\_array(p,n,\*i2,\*i1);printf("(i2=%d i1=%d)\n",\*i2,\*i1);  temp\_swap=p[\*i2]; p[\*i2]=p[n-1]; p[n-1]=temp\_swap; ++\*i2;  print\_indent(indent);printf("|\\");print\_array(p,n,\*i2,\*i1);printf("(i2=%d)\n",\*i2);  print\_indent(indent);printf("\\\n");  }  void sort(int\*p,int n,int indent=0)  {  int i1,i2;  print\_indent(indent);printf("(n=%d)",n);printf("\n");  split(p,n,&i1,&i2,indent);  if(i1>0)sort(p,i1+1,indent+2);  if(n-i2-1>0)sort(p+i2,n-i2,indent+2);  } | |
| 选择排序   |  | | --- | | 简单选择排序  void sort(int\*p,int n)  {  int i,j,i\_min,temp\_swap;  for(i=0;i!=n-1;++i)  {  i\_min=i;  for(j=i+1;j!=n;++j)  {  if(p[j]<p[i\_min])  {  i\_min=j;  }  }  if(i\_min!=i)  {  printf("(i=%d i\_min=%d)",i,i\_min);print\_array(p,n,i,i\_min);printf("\n");  temp\_swap=p[i];p[i]=p[i\_min];p[i\_min]=temp\_swap;  printf("(i=%d i\_min=%d)",i,i\_min);print\_array(p,n,i,i\_min);printf("\n");  }  }  } | | 堆排序  堆  void heap\_refresh(int\*p,int n,int current)  {  int child=current\*2+1,temp\_swap;  for(;child<n;current=child,child=child\*2+1)  {  if(child+1<n&&p[child]<p[child+1])++child;  if(p[current]>=p[child])return;  print\_heap(p,n,current,child,4);printf("(current=%d child=%d)",current,child);printf("\n");  temp\_swap=p[current];p[current]=p[child];p[child]=temp\_swap;  print\_heap(p,n,current,child,4);printf("(current=%d child=%d)",current,child);printf("\n\n");  }  }  void sort(int\*p,int n)  {  int i,temp\_swap;  for(i=n/2-1;i!=0;--i)  {  print\_heap(p,n,i,-1);printf("\n");  heap\_refresh(p,n,i);  }  printf("\n");  for(i=n;i!=1;--i)  {  print\_heap(p,i);printf("\n");  heap\_refresh(p,i,0);  print\_array(p,n,0,i-1);printf("\n");  temp\_swap=p[i-1];p[i-1]=p[0];p[0]=temp\_swap;  print\_array(p,n,0,i-1);printf("\n");  }  } | |
| 归并排序  分治法  void sort(int\*p,int n,int indent=0)  {  int i,i1,i2;  int mid=(n-1)/2,n1=mid+1,n2=n-n1;  print\_indent(indent);print\_array(p,n1);printf("+");print\_array(p+n1,n2);printf("(n=%d)\n",n);  if(n1>1)sort(p,n1,indent+3);  if(n2>1)sort(p+n1,n2,indent+3);  print\_indent(indent);print\_array(p,n1);printf("+");print\_array(p+n1,n2);printf("(n=%d)\n",n);  int\*p\_temp=new int[n]();  i=i1=i2=0;  while(i1!=n1&&i2!=n2)  {  if(p[i1]<(p+n1)[i2])  {  p\_temp[i]=p[i1];  print\_indent(indent+2);print\_array(p,n1,i1);print\_array(p+n1,n2,i2);printf("(i1=%d i2=%d)\n",i1,i2);  ++i1;  }  else  {  p\_temp[i]=(p+n1)[i2];  print\_indent(indent+2);print\_array(p,n1,i1);print\_array(p+n1,n2,i2);printf("(i1=%d i2=%d)\n",i1,i2);  ++i2;  }  ++i;  print\_indent(indent+2);print\_array(p\_temp,i,i-1);printf("\n");  }  for(;i1!=n1;++i1,++i)  {  p\_temp[i]=p[i1];  }  for(;i2!=n2;++i2,++i)  {  p\_temp[i]=(p+n1)[i2];  }  for(i=0;i!=n;++i)  {  p[i]=p\_temp[i];  }  print\_indent(indent);print\_array(p,n);printf("(n=%d)\n",n);  delete[]p\_temp;  } |
| 分配排序   |  | | --- | | 基数排序  前缀和 | | 桶排序  void sort(int\*p,int n,int max)//[0,max)  {  int\*p\_temp=new int[max]();  int i,j=0;  for(i=0;i!=n;++i)  {  ++(p\_temp[p[i]]);  }  for(i=0;i!=max;++i)  {  while(p\_temp[i]>0)  {  p[j]=i;  ++j;  --(p\_temp[i]);  printf("(i=%d p2[i]=%d)",i,p\_temp[i]);print\_array(p,j,j-1);printf("\n");  }  }  delete[]p\_temp;  } | |

顺序统计量

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| int main()  {  int i,j,max=100;  const int n=10;  int a[n];  srand(time(NULL));  for(i=0;i!=n;++i)  {  a[i]=rand()%max;  }  print\_array(a,n);printf("\n");  i=rand()%10;  printf("(i=%d)\n\n",i);  printf("%d\n\n",select(a,n,i));  } |

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| int split(int\*p,int n,int indent=0)  {  print\_indent(indent);printf("/\n");  int i,j,temp\_swap;  print\_indent(indent);printf("|");print\_array(p,n,-1,n-1);printf("\n");  i=0;j=n-2;  print\_indent(indent);printf("|");printf("(i=%d j=%d)\n",i,j);  while(1)  {  while(i!=n-1&&p[i]<=p[n-1])  {  ++i;  }  while(j!=-1&&p[j]>=p[n-1])  {  --j;  }  if(i<j)  {  temp\_swap=p[i];p[i]=p[j];p[j]=temp\_swap;  print\_indent(indent);printf("|");print\_array(p,n,i,j);printf("(i=%d j=%d)",i,j);printf("\n");  }  else  {  break;  }  }  print\_indent(indent);printf("|");printf("(i=%d j=%d)\n",i,j);  temp\_swap=p[i];p[i]=p[n-1];p[n-1]=temp\_swap;  print\_indent(indent);printf("|");print\_array(p,n,i,n-1);printf("\n");  print\_indent(indent);printf("\\\n");  return i;  }  int select(int\*p,int n,int i,int indent=0)//i:[0,n)  {  if(n==1)  {  return p[0];  }  print\_indent(indent);printf("(i=%d)\n",i);  print\_indent(indent);print\_array(p,n);printf("\n");  int n2=split(p,n,indent+1);  print\_indent(indent);print\_array(p,n,n2);printf("\n");  if(i==n2)  {  return p[n2];  }  else  {  if(i<n2)  {  print\_indent(indent);print\_array(p,n,0,n2-1);printf("\n");  return select(p,n2,i,indent+1);  }  else  {  print\_indent(indent);print\_array(p,n,n2+1,n-1);printf("\n");  return select(p+n2+1,n-n2-1,i-n2-1,indent+1);  }  }  } |

数论

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| gcd  #include<stdio.h>  #include<stdlib.h>  #include<time.h>  int gcd1(int i,int j,int&n\_recursion)//i>=j  {  ++n\_recursion;  int r;  if((r=i%j)==0)  {  return j;  }  else  {  return(r<j-r)  ?gcd1(j-r,r,n\_recursion)  :gcd1(r,j-r,n\_recursion);  }  }  int gcd2(int i,int j,int&n\_recursion)  {  ++n\_recursion;  return j?gcd2(j,i%j,n\_recursion):i;  }  int main()  {  srand(time(NULL));  int i,temp1,temp2,n\_recursion;  for(i=20;i!=40;++i)  {  temp1=rand()%1000;  temp2=rand()%1000+1;  n\_recursion=0;  printf("(%d,%d)=%d\t",temp1,temp2,gcd1(temp1,temp2,n\_recursion));  printf("%d\t",n\_recursion);  n\_recursion=0;  printf("(%d,%d)=%d\t",temp1,temp2,gcd2(temp1,temp2,n\_recursion));  printf("%d\n",n\_recursion);  }  } |
| ex\_gcd  #include<stdio.h>  #include<stdlib.h>  #include<time.h>  void print\_indent(int indent=0)  {  int i;  for(i=0;i!=indent;++i)  {  printf(" ");  }  }  void ex\_gcd(int a,int b,int&x,int&y,int&gcd,int indent=0)  {  if(a%b==0)  {  gcd=b;  x=0;  y=1;  print\_indent(indent);printf("%d \* %d + %d \* %d = %d\n",a,x,b,y,gcd);  }  else  {  int tempx,tempy;  ex\_gcd(b,a%b,tempx,tempy,gcd,indent+2);  print\_indent(indent);printf("%d \* %d + (%d - %d / %d) \* %d = %d\n",b,tempx,a,a,b,tempy,gcd);  x=tempy;  y=tempx-a/b\*tempy;  print\_indent(indent);printf("%d \* %d + %d \* %d = %d\n",a,x,b,y,gcd);  }  }  int main()  {  int i,a,b,x,y,gcd;  srand(time(NULL));  for(i=0;i!=5;++i)  {  a=rand()%500+200;  b=rand()%500+200;  ex\_gcd(a,b,x,y,gcd);  printf("\n");  }  } |
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