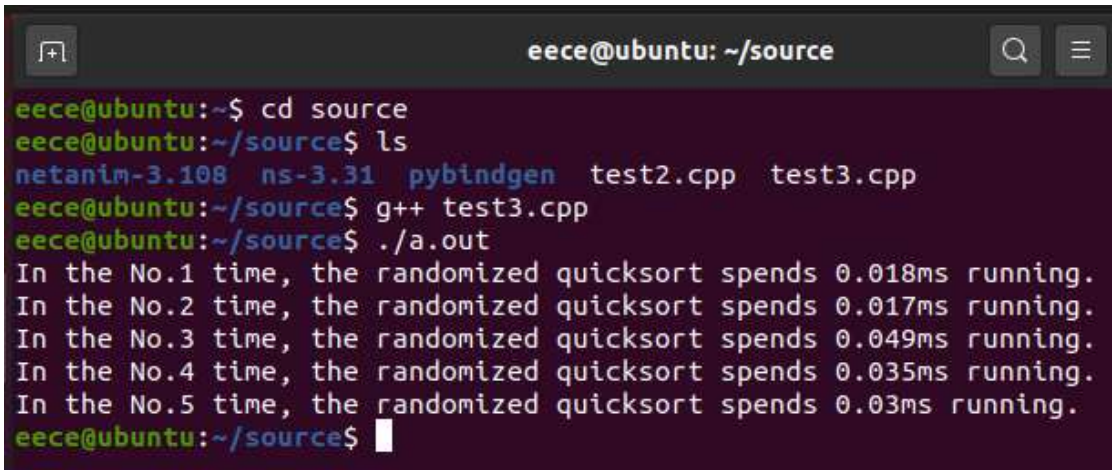
Question1

A: The code of this question is as following:

```
#include<iostream>
#include<stdlib.h>
#include<ctime>
using namespace std;

int partition(int A[],int p,int q)
{
	int d,i,j,x;
	x = A[p];
	i = p;
	for (j = p + 1; j <= q; j++)
	{
		d = 0;
		if (A[j] <= x)
		{
			i++;
			d = A[j];
			A[j] = A[i];
			A[i] = d;
		}
	}
	d = A[i];
	A[i] = A[p];
	A[p] = d;
	return i;
}

int randomized_partition(int A[], int p, int q)
{
	int i,d,k;
	i = (int)((double)rand()/RAND_MAX)%(q-p)+p;
	d = A[i];
	A[i] = A[p];
	A[p] = d;
	k = partition(A, p, q);
	return k;
}

void randomized_quicksort(int A[], int p, int q)
{
```

```
    int r;
    if (p < q)
    {
        r = randomized_partition(A, p, q);
        randomized_quicksort(A, p, r - 1);
        randomized_quicksort(A, r + 1, q);
    }
}

int main()
{
    int A[101];
    int i,d;
    double n;
    clock_t start, end;
    for (i = 1; i <=100; i++)
    {
        A[i] = i ;
    }
      for(i=1;i<=5;i++)
      {
        start=clock();
    randomized_quicksort(A, 1, 100);
    end=clock();
    n= (double)(end - start) / (double)(CLOCKS_PER_SEC)*1000;
    cout<<"In the No."<<i<<" time, the randomized quicksort spends "<<n<<"ms running.";
    cout<<endl;
      }
}
```

And the result of the codes is shown as the picture below:



Question 2

A: Here is the codes of the question:

```
#include<iostream>
using namespace std;

void max_heapify(int A[], int i,int n)
{
	int d, left, right;
	int largest;
	left = 2 * i;
	right = 2 * i + 1;
	if ((left<=n) && (A[left] > A[i]))
		largest = left;
	else
		largest = i;
	if ((right<=n)&&(A[right]>A[largest]))
		largest = right;
	if (largest != i)
	{
		d = A[i];
		A[i] = A[largest];
		A[largest] = d;
		max_heapify(A, largest, n);
	}
}

void build_max_heap(int A[],int n)
{
	int i;
	for (i = n / 2; i >= 1; i--)
	{
		max_heapify(A,i,n);
	}
}

void print_vector(int v[], int n)
{
	int i;
	cout << "Vector:";
	for (i = 1; i <=n; i++)
		cout << " " << v[i];
	cout << endl;
```

```
}

int main()
{
	int A[101];
	int i,d,n;
	int largest;
	for (i = 1; i <=100; i++)
		A[i] = i;
	print_vector(A, 100);
	for (i = 1; i <=100; i++)
	{
		int num = rand() % 100+1;
		d = A[i];
		A[i] = A[num];
		A[num] = d;
	}
	d = 0;
	n = 100;
	print_vector(A, 100);
	build_max_heap(A, 100);
	for (i = 100; i >= 2; i--)
	{
		d = A[1];
		A[1] = A[i];
		A[i] = d;
		n--;
		max_heapify(A, 1, n);
	}
	print_vector(A, 100);
}
```

The result of the codes is the picture below:

Question3

A: Here is the codes of the question:

```
#include<iostream>
using namespace std;

void print_vector(int v[], int n)
{
	int i;
	cout << "Vector:";
		for (i = 0; i < n; i++)
			cout << " " << v[i];
		cout << endl;
}

int main()
{
	int A[11] = {20,18,5,7,16,10,9,3,12,14,0 };
	int B[11];
	int C[21];
	int i,j;
	print_vector(A, 11);
	for (i = 0; i < 21; i++)
		C[i] = 0;
	for (j = 0; j <11; j++)
		C[A[j]] = C[A[j]] + 1;
	for (i = 1; i <21; i++)
		C[i] = C[i] + C[i - 1];
	for (j = 10; j >=0; j--)
	{
		B[C[A[j]]-1] = A[j];
		C[A[j]] = C[A[j]] -1;
	}
	print_vector(B, 11);
}
```

The result of the codes is shown in the picture below:

```
Vector: 20 18 5 7 16 10 9 3 12 14 0
Vector: 0 3 5 7 9 10 12 14 16 18 20
```

Question4:

A: Here is the codes of the question:

```
#include<iostream>
using namespace std;

void print_vector(int v[], int n)
{
	int i;
	cout << "Vector:";
	for (i = 0; i < n; i++)
		cout << " " << v[i];
	cout << endl;
}

int main()
{
	int A[7] = { 329,457,657,839,436,720,353 };
	int B[7];
	int C[10];
	int i, j;
	print_vector(A, 7);
	for(i=0;i<10;i++)
		C[i] = 0;
	for (j = 0; j < 7; j++)
		C[(A[j] % 10)] = C[(A[j] % 10)] + 1;
	for (i = 1; i < 10; i++)
		C[i] = C[i] + C[i - 1];
	for (j = 6; j >= 0; j--)
	{
		B[C[(A[j] % 10)] - 1] = A[j];
		C[(A[j] % 10)] = C[(A[j] % 10)] - 1;
	}
	for (j = 0; j < 7; j++)
	{
		A[j] = B[j];
	}
	for (i = 0; i < 10; i++)
		C[i] = 0;
	for (j = 0; j < 7; j++)
		C[((A[j]/10)%10)] = C[((A[j] / 10) % 10)] + 1;
	for (i = 1; i < 10; i++)
		C[i] = C[i] + C[i - 1];
```

```
    for (j = 6; j >= 0; j--)
    {
        B[C[((A[j] / 10) % 10)] - 1] = A[j];
        C[((A[j] / 10) % 10)] = C[((A[j] / 10) % 10)] - 1;
    }
    for (j = 0; j < 7; j++)
    {
        A[j] = B[j];
    }
    for (i = 0; i < 10; i++)
        C[i] = 0;
    for (j = 0; j < 7; j++)
        C[(A[j]/100)] = C[(A[j] / 100)] + 1;
    for (i = 1; i < 10; i++)
        C[i] = C[i] + C[i - 1];
    for (j = 6; j >= 0; j--)
    {
        B[C[(A[j] / 100)] - 1] = A[j];
        C[(A[j] / 100)] = C[(A[j] / 100)] - 1;
    }

    print_vector(B, 7);
}
```

The result of the codes is shown in the picture below:

```
Vector: 329 457 657 839 436 720 353
Vector: 329 353 436 457 657 720 839
```