Assignment A2_a

Sort array in parent and child ; And implement parent-child
synchronization, orphan and zombie process.

Code:

```c
#include<sys/types.h>
#include<stdio.h>
#include<stdlib.h>
#include<unistd.h>

void mergeSort(int arr[], int l, int r);
void merge(int arr[], int l, int m, int r);

int main(){
    pid_t pid;

    int n, choice;
    printf("Enter size of array: ");
    scanf("%d", &n);

    int arr[n];


    printf("Enter elements of array: ");
    for(int i=0;i<n;i++)
        scanf("%d", &arr[i]);

    printf("--- Select option ---\n 1. Synchronize parent and child\n2.
Orphan process\n3. Zombie process\n\n Your choice: ");
    scanf("%d", &choice);

    pid = fork();

    if(!pid){
        // In child
        printf("Child: Original array = ");
        for(int i=0;i<n;i++)
```

```c
            printf("%d ", arr[i]);
        printf("\n\n");

        mergeSort(arr, 0, n-1);

        printf("Child: Sorted array = ");
        for(int i=0;i<n;i++)
            printf("%d ", arr[i]);
        printf("\n\n");

        if(choice==1)
            exit(0); // Sync
        else if (choice == 2)
        {
            // Orphan
            sleep(10);
            printf("Orphan process\nChild %d adopted by %d\n", getpid(),
getppid());
            system("ps -la");
            printf("\n\n");
        }
        else
        {
            // Zombie
            printf("Child %d becomes zombie\n", getpid());
            exit(0);
        }

    } else if (pid==-1){
        printf("Error while forking!");
    } else {
        // In parent (pid=child's pid)
        printf("Parent: Original array = ");
        for(int i=0;i<n;i++)
            printf("%d ", arr[i]);
        printf("\n\n");

        mergeSort(arr, 0, n-1);

        printf("Parent: Sorted array = ");
```

```c
        for(int i=0;i<n;i++)
            printf("%d ", arr[i]);
        printf("\n\n");

        if(choice==1){
            // Sync
            pid_t child_pid;
            child_pid = wait(NULL);

            printf("Parent: Child %d has finished\n", child_pid);
        } else if(choice==2){
            // Orphan
            // Do nothing so that main() returns and process exits
            printf("Parent exiting\n\n");
        } else
        {
            // Zombie
            sleep(10);
            system("ps -la");
            printf("\n\n");
        }

    }

    return 0;
}


void merge(int arr[], int l, int m, int r) {

int i, j, k;
int n1 = m - l + 1;
int n2 = r - m;

int L[n1], R[n2];

for (i = 0; i < n1; i++) {
    L[i] = arr[l + i];
}
for (j = 0; j < n2; j++) {
```

```c
        R[j] = arr[m + 1 + j];
    }

    i = 0;
    j = 0;
    k = l;

    while (i < n1 && j < n2) {
        if (L[i] <= R[j]) {
            arr[k] = L[i];
            i++;
        }
        else {
            arr[k] = R[j];
            j++;
        }
        k++;
    }

    while (i < n1) {
        arr[k] = L[i];
        i++;
        k++;
    }

    while (j < n2) {
        arr[k] = R[j];
        j++;
        k++;
    }
}

void mergeSort(int arr[], int l, int r) {

    if (l < r) {

        int m = l + (r - l) / 2;

        mergeSort(arr, l, m);
        mergeSort(arr, m + 1, r);
```

```
    merge(arr, l, m, r);
  }
}
```

Output:

1. Synchronize parent and child

```
→  a2_a ./a.out
Enter size of array: 4
Enter elements of array: 5 6 4 8
--- Select option ---
 1. Synchronize parent and child
2. Orphan process
3. Zombie process

 Your choice: 1
Parent: Original array = 5 6 4 8

Parent: Sorted array = 4 5 6 8

Child: Original array = 5 6 4 8

Child: Sorted array = 4568

Parent: Child 1264920 has finished
→  a2_a
```

2. Orphan process

```
→  a2_a ./a.out
Enter size of array: 5
Enter elements of array: 2 7 4 8 3
--- Select option ---
 1. Synchronize parent and child
2. Orphan process
3. Zombie process

 Your choice: 2
Parent: Original array = 2 7 4 8 3

Parent: Sorted array = 2 3 4 7 8

Parent exiting

Child: Original array = 2 7 4 8 3

Child: Sorted array = 23478

→  a2_a Orphan process
Child 1270442 adopted by 3034
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN   TTY          TIME CMD
4 S     0    1575    1573  0  80   0 - 64143 -        tty1     00:00:00 Xorg
0 S   110    1706    1573  0  80   0 -  1323 -        tty1     00:00:00 dbus-run-sessio
0 S   110    1707    1706  0  80   0 -  1878 -        tty1     00:00:00 dbus-daemon
0 S   110    1708    1706  0  80   0 - 123490 -       tty1     00:00:00 gnome-session-b
0 S   110    1736       1  0  80   0 - 76424 -        tty1     00:00:00 at-spi-bus-laun
0 S   110    1743    1736  0  80   0 -  1808 -        tty1     00:00:00 dbus-daemon
4 S   110    1772    1708  0  58   - - 1089906 -      tty1     00:00:05 gnome-shell
0 S   110    1801    1772  0  80   0 - 80179 -        tty1     00:00:00 ibus-daemon
0 S   110    1804    1801  0  80   0 - 43118 -        tty1     00:00:00 ibus-memconf
0 S   110    1807       1  0  80   0 - 49433 -        tty1     00:00:00 ibus-x11
0 S   110    1809       1  0  80   0 - 61535 -        tty1     00:00:00 ibus-portal
0 S   110    1819       1  0  80   0 - 40707 -        tty1     00:00:00 at-spi2-registr
0 S   110    1826       1  0  80   0 - 61341 -        tty1     00:00:00 xdg-permission-
0 S   110    1841       1  0  80   0 - 753420 -       tty1     00:00:00 gjs
0 S   110    1853       1  0  80   0 - 39025 -        tty1     00:00:00 dconf-service
0 S   110    1856    1708  0  80   0 - 118714 -       tty1     00:00:03 gsd-sharing
0 S   110    1857    1708  0  80   0 - 67772 -        tty1     00:00:00 gsd-wacom
0 S   110    1860    1708  0  80   0 - 126414 -       tty1     00:00:01 gsd-color
0 S   110    1861    1708  0  80   0 - 86339 -        tty1     00:00:00 gsd-keyboard
0 S   110    1863    1708  0  80   0 - 64496 -        tty1     00:00:00 gsd-print-notif
0 S   110    1866    1801  0  80   0 - 43116 -        tty1     00:00:00 ibus-engine-sim
0 S   110    1871    1708  0  80   0 - 116716 -       tty1     00:00:00 gsd-rfkill
0 S   110    1874    1708  0  80   0 - 81273 -        tty1     00:00:00 gsd-smartcard
0 S   110    1875    1708  0  80   0 - 95886 -        tty1     00:00:00 gsd-datetime
0 S   110    1877    1708  0  80   0 - 172092 -       tty1     00:00:00 gsd-media-keys
0 S   110    1883    1708  0  80   0 - 79752 -        tty1     00:00:00 gsd-screensaver
0 S   110    1884    1708  0  80   0 - 82297 -        tty1     00:00:00 gsd-sound
0 S   110    1890    1708  0  80   0 - 79898 -        tty1     00:00:00 gsd-a11y-settin
0 S   110    1893    1708  0  80   0 - 80413 -        tty1     00:00:02 gsd-housekeepin
0 S   110    1895    1708  0  80   0 - 192410 -       tty1     00:00:00 gsd-power
0 S   110    1945       1  0  80   0 - 87988 -        tty1     00:00:00 gsd-printer
4 S     0    3150    3148  1  80   0 - 76577 -        tty2     00:21:00 Xorg
0 S  1000    3168    3148  0  80   0 - 49545 poll_s   tty2     00:00:00 gnome-session-b
1 S  1000 1270442    3034  0  80   0 -   625 do_wai   pts/0    00:00:00 a.out
0 S  1000 1270862 1270442  0  80   0 -   655 do_wai   pts/0    00:00:00 sh
4 R  1000 1270863 1270862  0  80   0 -  5296 -        pts/0    00:00:00 ps
```

3. Zombie process

```
→ a2_a ./a.out
Enter size of array: 7
Enter elements of array: 3 1 7 4 0 2 6
--- Select option ---
 1. Synchronize parent and child
2. Orphan process
3. Zombie process

 Your choice: 3
Parent: Original array = 3 1 7 4 0 2 6

Parent: Sorted array = 0 1 2 3 4 6 7

Child: Original array = 3 1 7 4 0 2 6

Child: Sorted array = 0123467

Child 1277377 becomes zombie
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
4 S     0    1575    1573  0  80   0 - 64143 -       tty1     00:00:00 Xorg
0 S   110    1706    1573  0  80   0 -  1323 -       tty1     00:00:00 dbus-run-sessio
0 S   110    1707    1706  0  80   0 -  1878 -       tty1     00:00:00 dbus-daemon
0 S   110    1708    1706  0  80   0 - 123490 -      tty1     00:00:00 gnome-session-b
0 S   110    1736       1  0  80   0 - 76424 -       tty1     00:00:00 at-spi-bus-laun
0 S   110    1743    1736  0  80   0 -  1808 -       tty1     00:00:00 dbus-daemon
4 S   110    1772    1708  0  58   - - 1089906 -     tty1     00:00:05 gnome-shell
0 S   110    1801    1772  0  80   0 - 80179 -       tty1     00:00:00 ibus-daemon
0 S   110    1804    1801  0  80   0 - 43118 -       tty1     00:00:00 ibus-memconf
0 S   110    1807       1  0  80   0 - 49433 -       tty1     00:00:00 ibus-x11
0 S   110    1809       1  0  80   0 - 61535 -       tty1     00:00:00 ibus-portal
0 S   110    1819       1  0  80   0 - 40707 -       tty1     00:00:00 at-spi2-registr
0 S   110    1826       1  0  80   0 - 61341 -       tty1     00:00:00 xdg-permission-
0 S   110    1841       1  0  80   0 - 753420 -      tty1     00:00:00 gjs
0 S   110    1853       1  0  80   0 - 39025 -       tty1     00:00:00 dconf-service
0 S   110    1856    1708  0  80   0 - 118714 -      tty1     00:00:03 gsd-sharing
0 S   110    1857    1708  0  80   0 - 67772 -       tty1     00:00:00 gsd-wacom
0 S   110    1860    1708  0  80   0 - 126414 -      tty1     00:00:01 gsd-color
0 S   110    1861    1708  0  80   0 - 86339 -       tty1     00:00:00 gsd-keyboard
0 S   110    1863    1708  0  80   0 - 64496 -       tty1     00:00:00 gsd-print-notif
0 S   110    1866    1801  0  80   0 - 43116 -       tty1     00:00:00 ibus-engine-sim
0 S   110    1871    1708  0  80   0 - 116716 -      tty1     00:00:00 gsd-rfkill
0 S   110    1874    1708  0  80   0 - 81273 -       tty1     00:00:00 gsd-smartcard
0 S   110    1875    1708  0  80   0 - 95886 -       tty1     00:00:00 gsd-datetime
0 S   110    1877    1708  0  80   0 - 172092 -      tty1     00:00:00 gsd-media-keys
0 S   110    1883    1708  0  80   0 - 79752 -       tty1     00:00:00 gsd-screensaver
0 S   110    1884    1708  0  80   0 - 82297 -       tty1     00:00:00 gsd-sound
0 S   110    1890    1708  0  80   0 - 79898 -       tty1     00:00:00 gsd-a11y-settin
0 S   110    1893    1708  0  80   0 - 80413 -       tty1     00:00:02 gsd-housekeepin
0 S   110    1895    1708  0  80   0 - 192410 -      tty1     00:00:00 gsd-power
0 S   110    1945       1  0  80   0 - 87988 -       tty1     00:00:00 gsd-printer
4 S     0    3150    3148  1  80   0 - 76426 -       tty2     00:21:05 Xorg
0 S  1000    3168    3148  0  80   0 - 49545 poll_s tty2     00:00:00 gnome-session-b
0 S  1000 1276285 1217674  0  80   0 -   625 do_wai pts/0   00:00:00 a.out
1 Z  1000 1277377 1276285  0  80   0 -     0 -       pts/0   00:00:00 a.out <defunct>
0 S  1000 1277789 1276285  0  80   0 -   655 do_wai pts/0   00:00:00 sh
4 R  1000 1277790 1277789  0  80   0 -  5296 -       pts/0   00:00:00 ps
```