

# MTE 241 Project 2

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## **Objectives:**

Implement task management in a Real-time OS using semaphores.

## **Summary**

The Keil RTX RTOS is a deterministic real-time Operating System designed for ARM and Cortex-M devices. The goal of this project is to create a new task to sort each sub-array when quicksort is called recursively. It is to be ensured that different tasks are properly coordinated to manage tasks that need to complete first are processed before other tasks are resumed (parent-child relationship).

The quick sort algorithm is performed on a large array recursively, by adding new tasks as needed, divides the array into shorter sub-arrays until the size is smaller than the threshold value. Once the size of the sub-arrays reaches the threshold value, the insertion algorithm will be performed as an in-place sorting algorithm to complete sorting and return the sorted array.

## Key Functions Implemented

```
void insertion_sort( array_interval_t interval )
```

Performs an in-place insertion sort on the sub-arrays which are produced by quick sort. The length of the sub-arrays is specified by the threshold value.

```
int find_median(int intNumOne, int intNumTwo, int intNumThr)
```

Finds the median of three numbers passed to the function. The function is used to find the pivot point in the array. Finding the ideal (middle) pivot point is one of the factors that affects the run-time.

```
__task void quick_sort_task( void* void_ptr)
```

This function is a task, defined with the task attribute `__task`. The function first performs the defined quick sort by finding the pivot and arranging the sub-arrays. It is followed by setting up the values to pass along to the child tasks to be created. The child tasks are created, values are passed, and the task is destroyed upon completion.

```
__task void quick_sort_sem_task( void* void_ptr)
```

This task is responsible for implementing quicksort using semaphores (Semaphore is an ADT that can facilitate and restrict access

to shared resources in a multi-processing environment). Counting semaphores are used in this function to indicate whether the interval is short enough to be performed insertion sort, which is determined by the predefined threshold value.