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Homework 5 – New MST

CS 6515: Introduction to Graduate Algorithms

**Algorithm:**

* To find the MST of *G'* we will utilize the DFS algorithm and the graph of *G'*.
* First, make a copy of MST *T* and remove edge *e* from it. Call this *T'*.
* Pass *T'* into DFS, identifying the connected components in the graph using *ccnum[]*.
* Next, traverse graph *G'* and find candidate edges that will connect the connected components in *T'*.
  + Meaning we only consider edges that form a path between vertices *(u,v)* that are in different connected components in *T'*.
* Add the lowest weighted edge from the list of candidate edges to *T'*, and return *T'*.

**Correctness:**

* To find the MST of *G'*, we can utilize the existing MST *T* with edge *e* removed so that it does not need to be built from scratch.
* We pass *T'* through DFS to identify the two connected components within the graph.
  + Since *T'* is an MST, removing one edge from the graph will give us two connected components.
* We can then traverse *G'* and create a candidate list of edges that would form a path between the two connected components in *T'*.
  + We only care about the edges from *G'* that connect the two connected components in *T'* so we can form a valid MST.
* We know from the Cut Property that any minimum edge across a cut is a part of some MST. So, we add the lowest weighted edge from our candidate list to *T'* and return *T'* as the MST of *G'*.

**Runtime:**

* Making a copy of *T*, running DFS as a blackbox on *T'*, and traversing *G'* takes O(n + m) time each.
* Removing exactly one edge in *T'* takes O(m) time.
* Overall runtime is O(n + m), which gets reduced to **O(m)** because we're running the algorithm on a connected graph.

**Collaborators:**

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