CSI 5342 Assignment 14.1

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The first step in specifying a location-aware role-based access control (LRBAC) model is to update our RBAC model from Assignment 13.1 to incorporate the Location class:

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The class and associations are based on the model developed in “LRBAC: A Location-Aware Role-Based Access Control Model” which incorporates locations with Users, Roles, Permissions, and Objects.

**Impact of Location on Role Hierarchies and SSD/DSD constraints**

Role Hierarchies contain a Senior-Junior relationship where the Senior roles can inherit the permissions of Junior roles or activate a Junior role. In the paper “A Spatio-Temporal Role-Based Access Control Model”, they outline 8 different hierarchical constraints based on unrestricted and restricted permission inheritance. Focusing only on the location-based constraints in definitions 11 and 12, we will add location restricted permission inheritance and location restricted activation constraints as follows:

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Next looking at SSD constraints, we need to ensure that a user cannot be assigned two roles that have SSD constraints while also taking into account the location of the user.

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Testing out the new constraint we have 2 script tests: InvalidSSDLocationTest.x and ValidSSDLocationTest.x. These basic files test out a basic session with one user, two roles, and two locations. When a user is assigned two roles with SSD constraints and when the locations overlap the invariant fails. We can see a successful state when the user only has one role assigned and does not have an SSD conflict.

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DSD constraints also need to be updated to ensure conflicting roles with the same location cannot be activated in the same session.

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To test these DSD constraints we can run our newly created InvalidDSDLocationTest.x and ValidDSDLocationTest.x for examples of the constraint in practice. In the first case, we have 2 conflicting roles for user 1 that are active in the same session. This causes our DSDconstraint to return False. We can fix this by removing role 2 from the active session and see that we have now satisfied our DSDconstraint:

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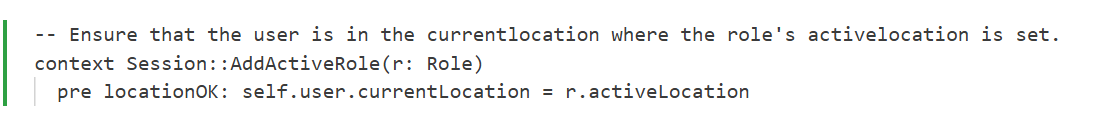
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Moving forward, we next started to update the CheckAccess operation in Session class. Before that however, we needed to update and add a few constraints to our model. The first one below is quite similar to the previous model, however with LRBAC, we had to add the check that the user’s current location was the same as the role’s assigned location. The rest stayed the same for that.  
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Next, we added another pre condition for a role to a session.



Quite similar to previously, we also needed to check the location was correct for the user’s session. So this was added as well. Next we also created a new association for SessionLocation between one location and many sessions at that said location.

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To further this, we updated the User::CreateSession() post conditions, to now link a user session   
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Lastly, we can now update the Session::CheckAccess() operation.

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To start off, we get all the roles unioned into a set. We first check the location of the role is valid for the user’s current location. Next, for each role, we then make sure some of the original attributes are valid, like that the object and operation are correct. Lastly, we should ensure that the user’s location is allowed by the roles permission and same goes for the object’s current location.  
  
To test this all out, we created a test file called `lrbac-valid.x`, this results in the following object diagram.

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In the example above, we basically just created one of each type of object and created their associations. Now, to test this out, we just run the following command by calling the session’s CheckAccess operation.  
  
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For this next test, we wanted to make sure a user with a different current location, than the object’s current location, would result in a false when returning from the Session::CheckAccess(). Below was the model generated via the ‘lrbac-invalid.x’ file.

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Running a test on this produce the correct result of false!

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In this last test for CheckAccess, we really decided to trick the model. We created 2 sets of objects for Object, Permission, Role, Location and Operation. For the user, we gave it one of the location’s that was attached to the O2 object. The below object diagram can further explain the relationships.

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As we can see, the only operation the user should have access to, based upon the current location of that user, is the OpWrite operation on O2 object. We tested this out, and here are some screenshotted results.   
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AI-generated content may be incorrect. This evaluates to false because that object and permission is attached to a location that differs from the user’s current location.

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AI-generated content may be incorrect. This evaluates to false, because that operation does not correlate to that object, so this also fails correctly.

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AI-generated content may be incorrect. Finally, this returns as true like expected. The user is in the current location for the operation and object, and has the correct roles to do this.

**Summary of each member’s contribution**

Matt and Rob both contributed equally to this project. They split the work up by having meetings and constantly reaching back and forth. We helped answer any questions we had. The regular meetings we scheduled greatly contributed to our understanding of this as a whole.