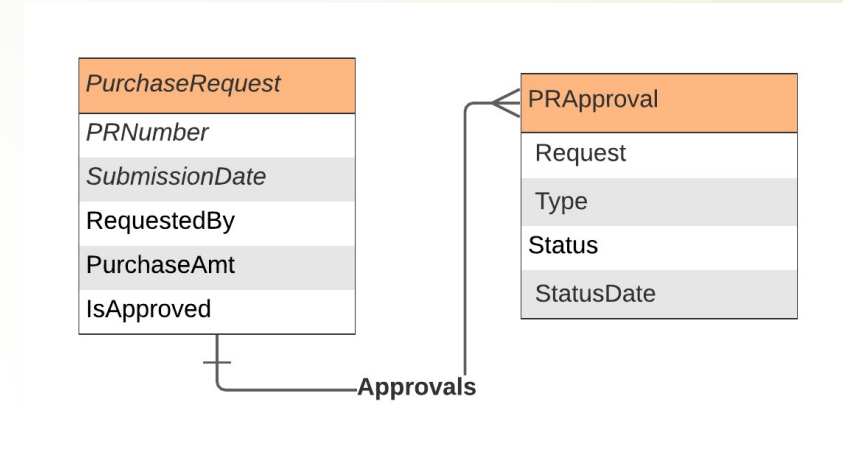# Purchase Request Approval Workflow

Domain Model

- Purchase Request
  - Represents a purchase request submitted with purchase amount and other attributes.
  - IsApproved indicates whether the request is approved or not at the end of the workflow.
- PR Approval
  - There are three different levels of approvals that may be required.
    - Project Manager (PM) Approval
    - Finance Manager (FM) Approval
    - CFO Approval

Workflow Rules

- For amounts less than $500, approve automatically.
- For amounts over $500, send it for PM approval.
- If PM rejects it, reject the PR and end the workflow.
- If PM approves it, send it for FM approval.
- If FM rejects it, reject the PR and end the workflow.
- If FM approves it:
  - If the amount is over $10,000, then send it for CFO approval.
  - Else, approve the PR and end the workflow.
- If CFO rejects, reject the PR and end the workflow.
- If CFO approves, approve the PR and end the workflow..

PurchaseRequest
- *PRNumber*
- *SubmissionDate*
- RequestedBy
- PurchaseAmt
- IsApproved

PRApproval
- Request
- Type
- Status
- StatusDate

Approvals

Modeling Concepts Illustrated

- PR Approval objects are generated dynamically based on purchase request data.

- PR Approvals are retracted based on workflow state and data.

In contrast to traditional workflow / Business Process Management (BPM) systems, we specify workflows as logical statements. Based on this speciation, Maximal dynamically composes workflows by creating necessary approvals.

Domain Model

```xml
<model xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://maximal.co">
    <object-type name="PurchaseRequest@eg.maximal.co" label="Purchase request">
        <attribute name="PRNumber" label="Purchase request Number" datatype="text" optional="false"/>
        <attribute name="SubmissionDate" label="Submission Date" datatype="date"/>
        <attribute name="RequestedBy" label="Requested by user" datatype="text"/>
        <attribute name="PurchaseAmt" label="Purchase amount" datatype="float"/>
        <attribute name="IsApproved" label="Approved or not." datatype="boolean"/>

        <relation name="Approvals" label="Approvals" inverse-object="PRApproval@eg.maximal.co"
            inverse-attribute="Request"/>
        <persistence-params table-name="pr_purchasereq"/>
    </object-type>

    <object-type name="PRApproval@eg.maximal.co" label="Purchase request approval." is-existential="true">
        <attribute name="Request" label="Purchase request" datatype="reference"
            ref-type="PurchaseRequest@eg.maximal.co"/>
        <attribute name="Type" label="Approval type" datatype="enumerated"
            enumtype="ApprovalTypeEnum@eg.maximal.co"/>
        <attribute name="Status" label="Approval status" datatype="enumerated"
            enumtype="ApprovalStatusEnum@eg.maximal.co" initial-value="PENDING"/>
        <attribute name="StatusDate" label="Status date" datatype="date"/>

        <persistence-params table-name="pr_approval"/>
    </object-type>

    <enum-type name="ApprovalTypeEnum@eg.maximal.co" label="Approval type enumeration">
        <enum-option name="PM" label="Project manager approval"/>
        <enum-option name="FM" label="Finance manager approval"/>
        <enum-option name="CFO" label="CFO approval"/>
    </enum-type>

    <enum-type name="ApprovalStatusEnum@eg.maximal.co" label="Approval status enumeration">
        <enum-option name="PENDING" label="Pending"/>
        <enum-option name="APPROVED" label="Approved"/>
        <enum-option name="REJECTED" label="Rejected"/>
    </enum-type>
</model>
```

This "is-existential" specification is important. This tells Maximal that the object PRApproval can be created from the constraint model based on other conditions being met.

Existential Quantifiers

➢ In formal logic, am "existential quantifier" is a statement like "there must exist X such that….".

➢ In this model, we use such statements to create PRApproval objects.

➢ When "is-existential" is specified, Maximal tracks an additional field named "ExistentialInd" for these objects. When ExisteintialInd is true, it means that object exists because the logic inferred it. When it is not true, the object may have been created by other means or that the object was retracted after initially getting created by the logic inference.

Workflow Logic

SET pr = PurchaseRequest@eg.maximal.co;
SET approval = pr.Approvals;
SET apr = pr.Approvals WHERE apr.ExistentialInd;
SET pmapr = pr.Approvals WHERE pmapr.Type=PM AND pmapr.ExistentialInd;
SET fmapr = pr.Approvals WHERE fmapr.Type=FM AND fmapr.ExistentialInd;
SET noapr = pr.Approvals WHERE noapr.Status IN [PENDING, REJECTED] AND noapr.ExistentialInd;

CONSTRAINT PR C1 "PM Approval is needed for every request with amount over $500."
    pr.PurchaseAmt>500 =>
    ENSURE approval WITH approval.Type=PM, approval.Request = pr;

CONSTRAINT PR C2 "If PM approves the request, create an approval for FM"
    pmapr.Status = APPROVED =>
    ENSURE approval WITH approval.Type=FM, approval.Request = pr;

CONSTRAINT PR C3 "If FM approves the request and the amount is over 10,000,
        then create an approval for CFO"
    (fmapr.Status=APPROVED AND pr.PurchaseAmt >10000) =>
    ENSURE approval WITH approval.Type=CFO, approval.Request = pr;

CONSTRAINT PR C4 "Request is approved if there are no pending or rejected approvals."
    SSIZE(noapr)=0 => pr.IsApproved;

CONSTRAINT PR C5 "Request is rejected if there are any rejected approvals."
    apr.Status=REJECTED => NOT pr.IsApproved;

This ENSURE tells Maximal to create a PRApproval object with Type and Request attributes set, when the amount is over $500.

When amount is over $500, Maximal creates a PRApproval and sets its ExistentialInd to true. If the amount is changed to below $500, the ExistentialInd will be set to null.

C4 and C5 are setting values for isApproved based on the state of individual approvals.
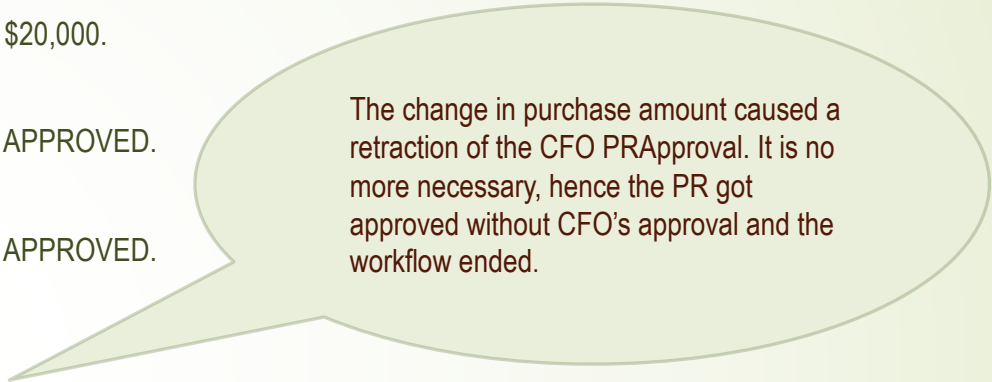
Testing the Workflow

Test 1

1. Create a purchase request with amount $20,000.
2. This creates a PRApproval for PM.
3. Update the status of this PRApproval to APPROVED.
4. This creates PRApproval for FM.
5. Update the status of this PRApproval to APPROVED.
6. This creates PRApproval for CFO.
7. Update the status of this PRApproval to APPROVED.
8. This changes purchase request's IsApproved to true.

Test 2

1. Create a purchase request with amount $20,000.
2. This creates a PRApproval for PM.
3. Update the status of this PRApproval to REJECTED..
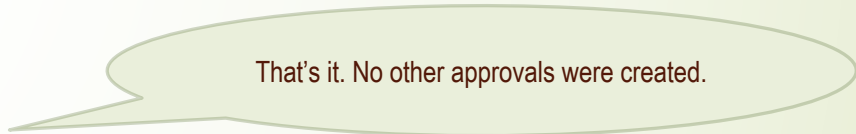4. This changes purchase request's IsApproved to false.

Test 3

1. Create a purchase request with amount $20,000.
2. This creates a PRApproval for PM.
3. Update the status of this PRApproval to APPROVED.
4. This creates PRApproval for FM.
5. Update the status of this PRApproval to APPROVED.
6. This creates PRApproval for CFO.
7. Now change the amount to $4,000.
8. This changes purchase request's IsApproved to true.

Test 4

1. Create a purchase request with amount $200.
2. This changes purchase request's IsApproved to true.

The change in purchase amount caused a retraction of the CFO PRApproval. It is no more necessary, hence the PR got approved without CFO's approval and the workflow ended.

That's it. No other approvals were created.

Summary

- Maximal offers a powerful logic-based specification of workflows.

- Most ideal for <u>data-dependent dynamic</u> workflows.

  - Maximal fluently mixes data and workflows and treats them uniformly in the same logical framework.

  - Most real-world complex case management require this functionality.

- Try modeling this simple workflow model in a traditional BPM platform.

  - How do you model retraction of PRApprovals when they are no longer needed?

  - How about scenarios where we need to incorporate even more complex data for driving workflows? Let's say if the average monthly spend of the requester determines the approval flow.