Exercises

1	2	3	4	5	6	7

1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9
0	0	0	0	0	0	0

Surname, First name

Principles of data protection (2IMS25)
Exam (November 10)

Particular Ans on paper exam instructions

- Write in a black or blue pen.
- You answer open-ended questions by using the text box. Provide your answers on the papers inside the answer box underneath a question. If you need more space for your answers, use the extra space at the end of the exam, and clearly indicate there which question you continue answering. In the text box of the particular question, clearly state that you proceed with your answer on a different page.
- Hand in all pages. Do not remove the staple. If you remove it anyhow, check that you hand in all pages.

Dear student,
You're about to take an exam. Write down your name and your student ID at the appropriate places above. Make sure that you enter your student ID by fully coloring the appropriate boxes. On the examination attendance card, you fill in a document number. You can find the correct number on the top of the first page of your exam (10 numbers).

Please read the following information carefully:
Date exam: 10/11/2021
Start time: 13.30
End time: 16.30 (+30 minutes for time extension students)

Number of questions: 6
Maximum number of points/distribution of points over questions: 10
Method of determining the final grade: Final exam
Answering style: formulation, order, foundation of arguments, multiple choice:

Permitted examination aids:
No aids are allowed.

Important:

- You are only permitted to visit the toilets under supervision
- Examination scripts (fully completed examination paper, stating name, student number, etc.) must

always be handed in
- The house rules must be observed during the examination
- The instructions of subject experts and invigilators must be followed
- Keep your work place as clean as possible: put pencil case and breadbox away, limit snacks and drinks
- You are not permitted to share examination aids or lend them to each other
- Do not communicate with any other person by any means

During written examinations, the following actions will in any case be deemed to constitute fraud or attempted fraud:
- using another person's proof of identity/campus card (student identity card)
- having a mobile telephone or any other type of media-carrying device on your desk or in your clothes
- using, or attempting to use, unauthorized resources and aids, such as the internet, a mobile telephone, smartwatch, smart glasses etc.
- having any paper at hand other than that provided by TU/e, unless stated otherwise
- copying (in any form)
- visiting the toilet (or going outside) without permission or supervision

You can start the exam now, good luck!

DAC

1.5p **1** Explain the safety problem in Harrison-Ruzzo-Ullman model. State under which condition(s) the safety problem is decidable.

Mandatory Access Control

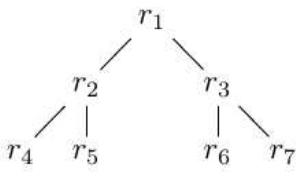
2p **2** Represent the Chinese Wall model in the BLP model. Specifically:

- Define a security lattice in which the Chinese Wall policy can be enforced.
- Show how the simple-property and star-property defined by Chinese Wall model can be modeled over such a lattice structure.

RBAC

The following Access Matrix has been generate from an RBAC_1 policy with the given hierarchy and where Eve has role r_7.

	Client Record	Financial Report	Loan Offer
Alice	read, update		make
Bob	read	read, update	approve
Charlie	read	read	
David	read	read, create	make
Eve	read	read	verify
Frank	read	read, update	make, approve



1.5p **3** Give the minimal User-Assignment and Permission-Assignment corresponding to the given Access Matrix such that you do not assign anything that can be already derived otherwise.

Hint: Users might have more than one role.

RT

0.5p **4a** We have explained that in trust management “there is no predefined security monitor”. (a) Explain what it means, (b) give an example of a situation in which there is no centralized security monitor and compare it to another example (that you have to provide as well) in which there is a centralized security monitor.

1p **4b** Consider the following RT_0 policy.

$A.t \leftarrow A.t.s$
$A.t \leftarrow A$
$A.t \leftarrow B$
$A.t \leftarrow C$

$A.s \leftarrow J$
$A.s \leftarrow K.t$

$A.v \leftarrow R$
$A.v \leftarrow S$

$K.t \leftarrow J$
$K.t \leftarrow K.u.v$

$K.u \leftarrow A$
$K.u \leftarrow B$
$K.u \leftarrow C$

$B.r \leftarrow A$
$B.r \leftarrow B$

$K.s \leftarrow A$
$K.s \leftarrow B$
$K.s \leftarrow C$

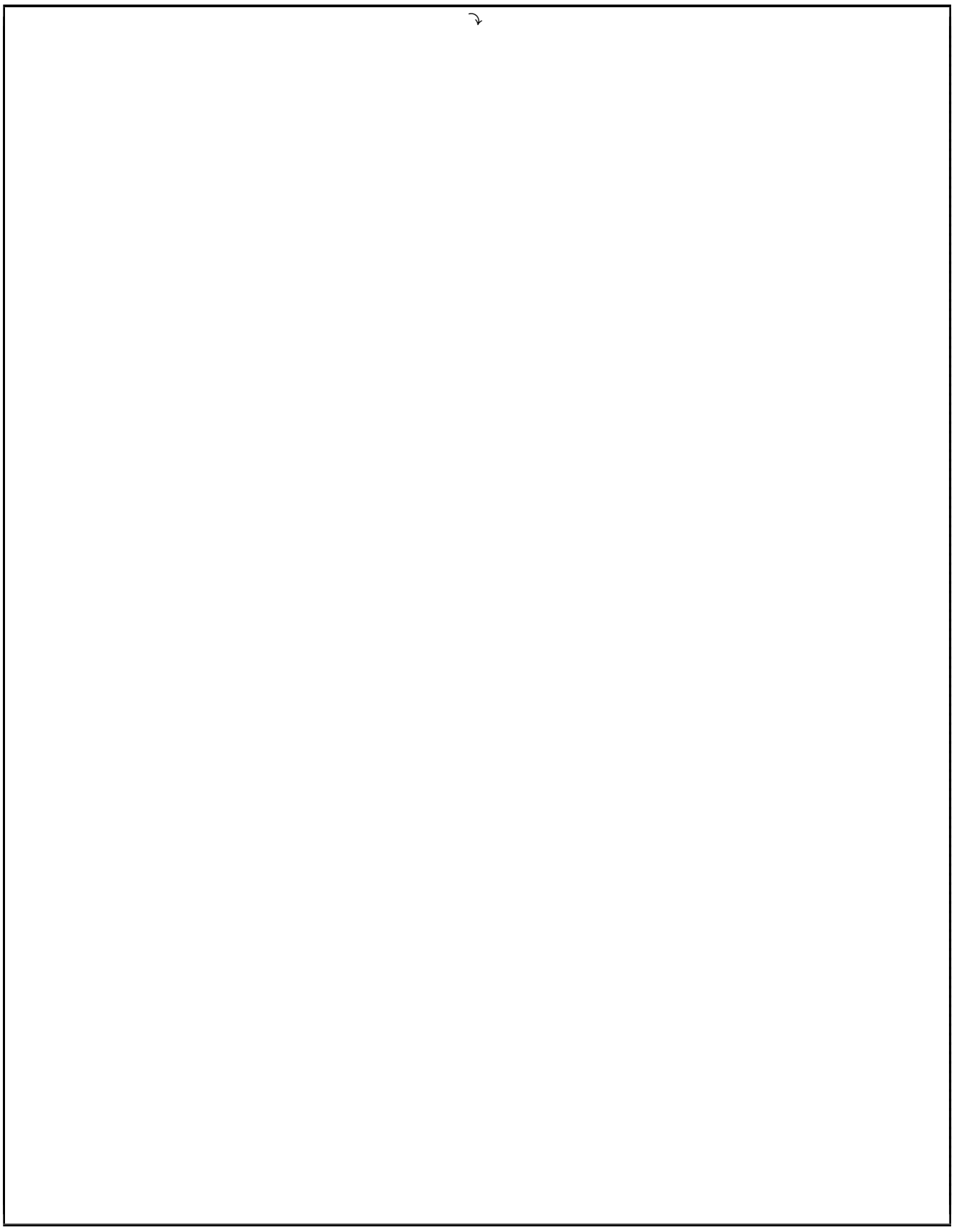
$K.t \leftarrow F$
$K.t \leftarrow G$
$K.t \leftarrow H$

$K.v \leftarrow L$
$K.v \leftarrow M$
$K.v \leftarrow N$

$J.s \leftarrow J$

- Find all principals populating $A.t$ (which means, compute $[[A.t]]$).
- Write down the graph generated by the top-down algorithm when computing the semantics of $A.t$ (the top-down algorithm is also known as the "backward algorithm").

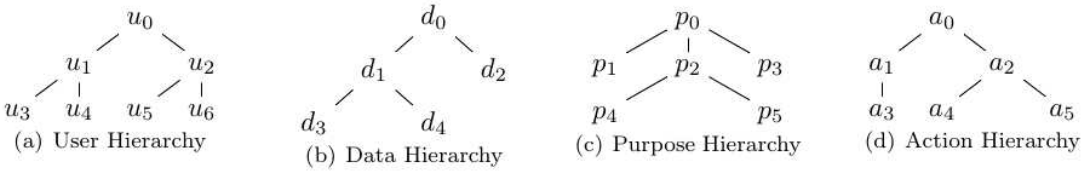
↳



EPAL

Let pol be an EPAL policy defined over the user hierarchy, data hierarchy, purpose hierarchy and action hierarchy in the figure below.

$$pol = \begin{cases} \langle (u_2, d_3, p_0, a_1)(+, true, o_1) \rangle \\ \langle (u_1, d_3, p_2, a_0)(\circ, true, o_2) \rangle \\ \langle (u_4, d_0, p_4, a_2)(+, true, o_3) \rangle \\ \langle (u_6, d_2, p_3, a_1)(-, true, o_4) \rangle \\ \langle (u_1, d_0, p_1, a_0)(\circ, true, o_5) \rangle \\ \text{Default ruling: } - \\ \text{Default obligations: } \{o_6\} \end{cases}$$



(a) User Hierarchy (b) Data Hierarchy (c) Purpose Hierarchy (d) Action Hierarchy

1.5p **5** Evaluate the following access requests against pol:

$req_1 = (u_3, d_4, p_1, a_3)$
$req_2 = (u_4, d_3, p_4, a_4)$
$req_3 = (u_6, d_0, p_0, a_1)$
$req_4 = (u_5, d_1, p_3, a_5)$

XACML

2p **6** Given the XACML policy and access request below, determine the access response.

Hint: If an attribute is missing (i.e., it is not provided in the request), then MustBePresent governs the applicability of the Rule/Policy/PolicySet.

- If MustBePresent is "False" (default value), then a missing attribute results in an empty bag. (i.e., the Rule/Policy/PolicysSet is "Not Applicable")
- If MustBePresent is "True", then a missing attribute results in an error. Recall that rule evaluation and some combining algorithms are defined over the extended Indeterminate set ("Indeterminate(P)", "Indeterminate(D)", "Indeterminate(PD)"). Decisions in the extended Indeterminate set indicate the potential decision(s) (Permit or Deny) that would have returned if an error have not occurred in the evaluation.

Extra space

7

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Access Request

```
 <Request>
   <Attributes
         Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject">
         <Attribute IncludeInResult="false"
            AttributeId="urn:oasis:names:tc:xacml:1.0:subject:subject-id">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                Alice
            </AttributeValue>
         </Attribute>
         <Attribute IncludeInResult="false"
            AttributeId="urn:oasis:names:tc:xacml:2.0:subject:role">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                accountant
            </AttributeValue>
         </Attribute>
         <Attribute IncludeInResult="false"
            AttributeId="urn:oasis:names:tc:xacml:2.0:subject:role">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                clerk
            </AttributeValue>
         </Attribute>
    </Attributes>
    <Attributes
         Category="urn:oasis:names:tc:xacml:3.0:attribute-category:resource">
         <Attribute IncludeInResult="false"
            AttributeId="urn:oasis:names:tc:xacml:1.0:resource:resource-id">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                FinacialRecord
            </AttributeValue>
         </Attribute>
    </Attributes>
    <Attributes
         Category="urn:oasis:names:tc:xacml:3.0:attribute-category:action">
         <Attribute IncludeInResult="false"
            AttributeId="urn:oasis:names:tc:xacml:1.0:action:action-id">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                write
            </AttributeValue>
         </Attribute>
    </Attributes>
 </Request>
```

```
<PolicySet PolicySetId="PS"
  xmlns="urn:oasis:names:tc:xacml:2.0:policy:schema:os"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  PolicyCombiningAlgId="urn:oasis:names:tc:xacml:3.0:policy-combining-algorithm:permit-overrides">
  <Target>
       <AnyOf>
          <AllOf>
           <Match
             MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
             <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                 write
             </AttributeValue>
             <AttributeDesignator
                 MustBePresent="false"
                 Category="urn:oasis:names:tc:xacml:3.0:attribute-category:action"
                 AttributeId="urn:oasis:names:tc:xacml:1.0:action:action-id"
                 DataType="http://www.w3.org/2001/XMLSchema#string"/>
           </Match>
          </AllOf>
        </AnyOf>
  </Target>
  <Policy PolicyId="P1"
    RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:rule-combining-algorithm:deny-overrides">
    <Target />
    <Rule Effect="Deny" RuleId="R1">
      <Target>
       <AnyOf>
         <AllOf>
           <Match
               MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
               <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                  manager
               </AttributeValue>
               <AttributeDesignator MustBePresent="false"
                   Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                   AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                   DataType="http://www.w3.org/2001/XMLSchema#string"/>
           </Match>
           <Match
               MatchId="urn:oasis:names:tc:xacml:1.0:function:time-greater-than">
               <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#time">
                  15:00
               </AttributeValue>
               <AttributeDesignator MustBePresent="true"
                   Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                   AttributeId="urn:oasis:names:tc:xacml:1.0:subject:authentication-time"
                   DataType="http://www.w3.org/2001/XMLSchema#time"/>
           </Match>
         </AllOf>
         <AllOf>
           <Match
               MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
               <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                  accountant
```

```
            </AttributeValue>
            <AttributeDesignator MustBePresent="false"
                Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                DataType="http://www.w3.org/2001/XMLSchema#string"/>
        </Match>
        <Match
            MatchId="urn:oasis:names:tc:xacml:1.0:function:time-greater-than">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#time">
               15:00
            </AttributeValue>
            <AttributeDesignator MustBePresent="false"
               Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
               AttributeId="urn:oasis:names:tc:xacml:1.0:subject:authentication-time"
               DataType="http://www.w3.org/2001/XMLSchema#time"/>
        </Match>
      </AllOf>
    </AnyOf>
  </Target>
</Rule>
<Rule Effect="Permit" RuleId="R2">
  <Target>
   <AnyOf>
     <AllOf>
       <Match
            MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
               accountant
            </AttributeValue>
            <AttributeDesignator MustBePresent="false"
                Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                DataType="http://www.w3.org/2001/XMLSchema#string"/>
       </Match>
       <Match
            MatchId="urn:oasis:names:tc:xacml:1.0:function:time-greater-than">
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#time">
               15:00
            </AttributeValue>
            <AttributeDesignator MustBePresent="true"
                Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                AttributeId="urn:oasis:names:tc:xacml:1.0:subject:authentication-time"
                DataType="http://www.w3.org/2001/XMLSchema#time"/>
       </Match>
     </AllOf>
    </AnyOf>
  </Target>
</Rule>
<Rule Effect="Deny" RuleId="R3">
  <Target>
   <AnyOf>
     <AllOf>
       <Match
            MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
```

```
            <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
               clerk
            </AttributeValue>
            <AttributeDesignator MustBePresent="true"
                Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                DataType="http://www.w3.org/2001/XMLSchema#string"/>
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       </AllOf>
       <AllOf>
         <Match
             MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
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                manager
             </AttributeValue>
             <AttributeDesignator MustBePresent="false"
                 Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                 AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                 DataType="http://www.w3.org/2001/XMLSchema#string"/>
         </Match>
       </AllOf>
      </AnyOf>
    </Target>
  </Rule>
  <Obligations>
    <Obligation FulfillOn="Permit" ObligationId="01" />
    <Obligation FulfillOn="Deny" ObligationId="02" />
  </Obligations>
</Policy>
<Policy PolicyId="P2"
   RuleCombiningAlgId="urn:oasis:names:tc:xacml:3.0:rule-combining-algorithm:first-applicable">
  <Target />
  <Rule Effect="Permit" RuleId="R4">
    <Target>
     <AnyOf>
       <AllOf>
         <Match
             MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
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                 accountant
             </AttributeValue>
             <AttributeDesignator MustBePresent="false"
                 Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                 AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                 DataType="http://www.w3.org/2001/XMLSchema#string"/>
         </Match>
       </AllOf>
     </AnyOf>
     <AnyOf>
       <AllOf>
         <Match
             MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
             <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                 manager
```

```
              </AttributeValue>
              <AttributeDesignator MustBePresent="false"
                  Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                  AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                  DataType="http://www.w3.org/2001/XMLSchema#string"/>
            </Match>
          </AllOf>
        </AnyOf>
      </Target>
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      <Target>
       <AnyOf>
         <AllOf>
           <Match
              MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
              <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
                 clerk
              </AttributeValue>
              <AttributeDesignator MustBePresent="false"
                  Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
                  AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:role"
                  DataType="http://www.w3.org/2001/XMLSchema#string"/>
            </Match>
          </AllOf>
        </AnyOf>
      </Target>
    </Rule>
    <Obligations>
      <Obligation FulfillOn="Permit" ObligationId="03" />
      <Obligation FulfillOn="Deny" ObligationId="04" />
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  </Policy>
  <Obligations>
    <Obligation FulfillOn="Permit" ObligationId="05" />
    <Obligation FulfillOn="Deny" ObligationId="06" />
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