Exercise 4.64.

Louis Reasoner mistakenly deletes the `outranked-by` rule (section 4.4.1) from the data base. When he realizes this, he quickly reinstalls it. Unfortunately, he makes a slight change in the rule, and types it in as

```
(rule (outranked-by ?staff-person ?boss)
      (or (supervisor ?staff-person ?boss)
          (and (outranked-by ?middle-manager ?boss)
               (supervisor ?staff-person ?middle-manager)))))
```

Just after Louis types this information into the system, DeWitt Aull comes by to find out who outranks Ben Bitdiddle. He issues the query

```
(outranked-by (Bitdiddle Ben) ?who)
```

After answering, the system goes into an infinite loop. Explain why.

Answer.

Finding that the `outranked-by` rule is applicable, the query system unifies the query

```
(outranked-by (Bitdiddle Ben) ?who)
```

with its conclusion to form an extension on the original empty frame, in which `?staff-person` is bound to `(Bitdiddle Ben)` and `?boss` is bound to `?who`. Then, relative to this extended frame, the interpreter proceeds to evaluate the rule body

```
(or (supervisor (Bitdiddle Ben) ?who)
    (and (outranked-by ?middle-manager ?who)
         (supervisor (Bitdiddle Ben) ?middle-manager)))
```

The first query in this `or` combination extends the stream of frame with the pattern variable `?who` bound to `(Warbucks Oliver)`. However, it is the `and` of two queries that make the interpreter falls into infinite loops in making deductions. Note that the interpreter immediately encounters the `outranked-by` rule again as it proceeds to handle the `and` combination. Unifying it extends the former frame with `?middle-manager` replacing `(Bitdiddle Ben)` and evaluates almost an identical rule body again

```
(or (supervisor ?middle-manager ?who)
    (and (outranked-by ?middle-manager ?who)
         (supervisor ?middle-manager ?middle-manager)))
```

Observe that the `outranked-by` rule unwind to reveal itself endlessly with no frame filtered away. Therefore, the query systems goes into an infinite loop while handling DeWitt Aull's query.