Nelson

用函數方式設計系統

Adelbert Chang
@adelbertchang

Anil Madhavapeddy @ Haskell 2014

We build applications in a **safe**, **compositional style** using functional programming...

Anil Madhavapeddy @ Haskell 2014

We build applications in a **safe**, **compositional style** using functional programming...

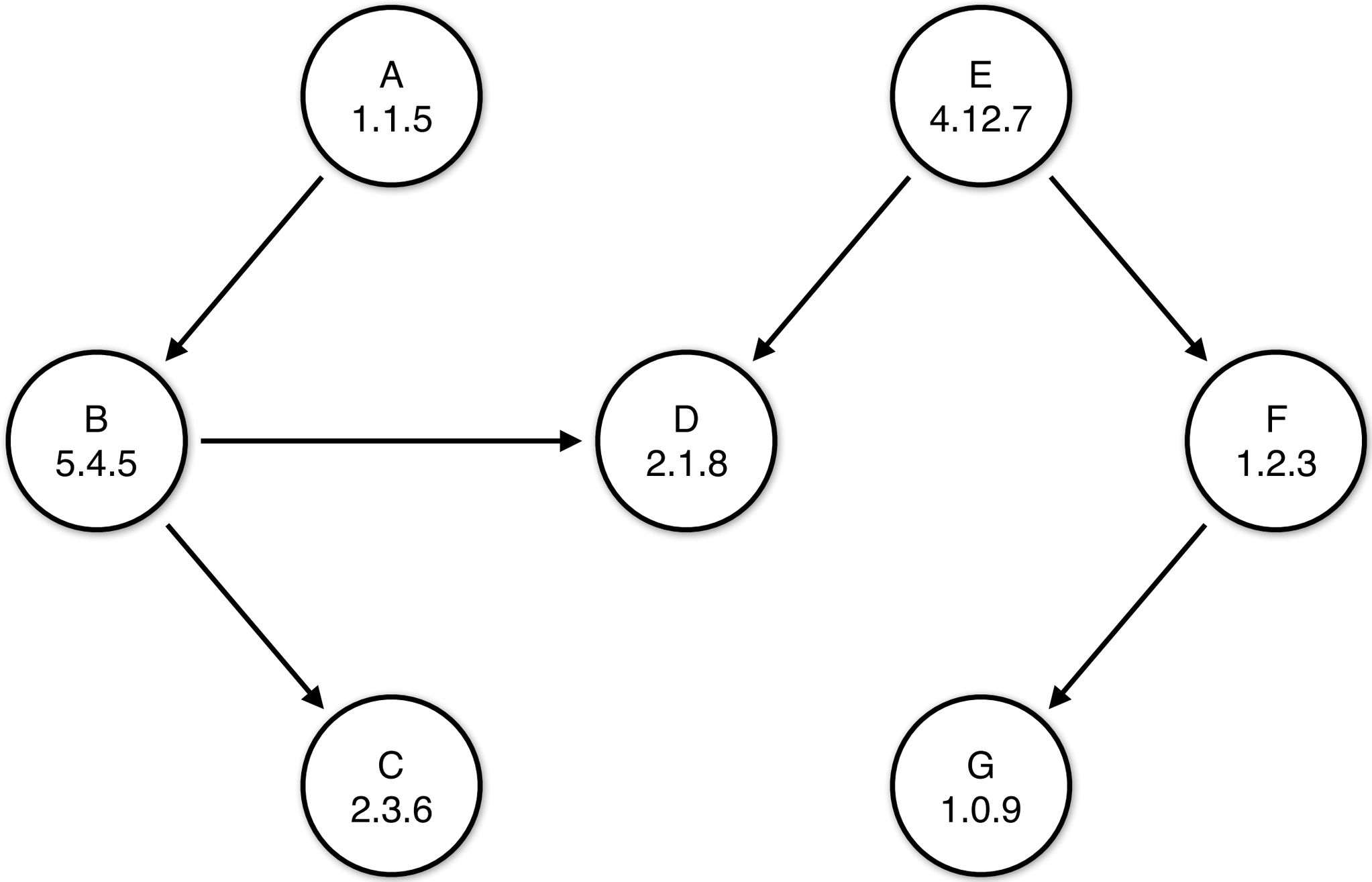
...and then surround it in **15 million lines of unsafe code** to interact with the outside world.

Anil Madhavapeddy @ Haskell 2014

We build applications in a **safe**, **compositional style** using functional programming...

...and then surround it in **mutable, complex infrastructure** to deploy it.

Mutable deployments



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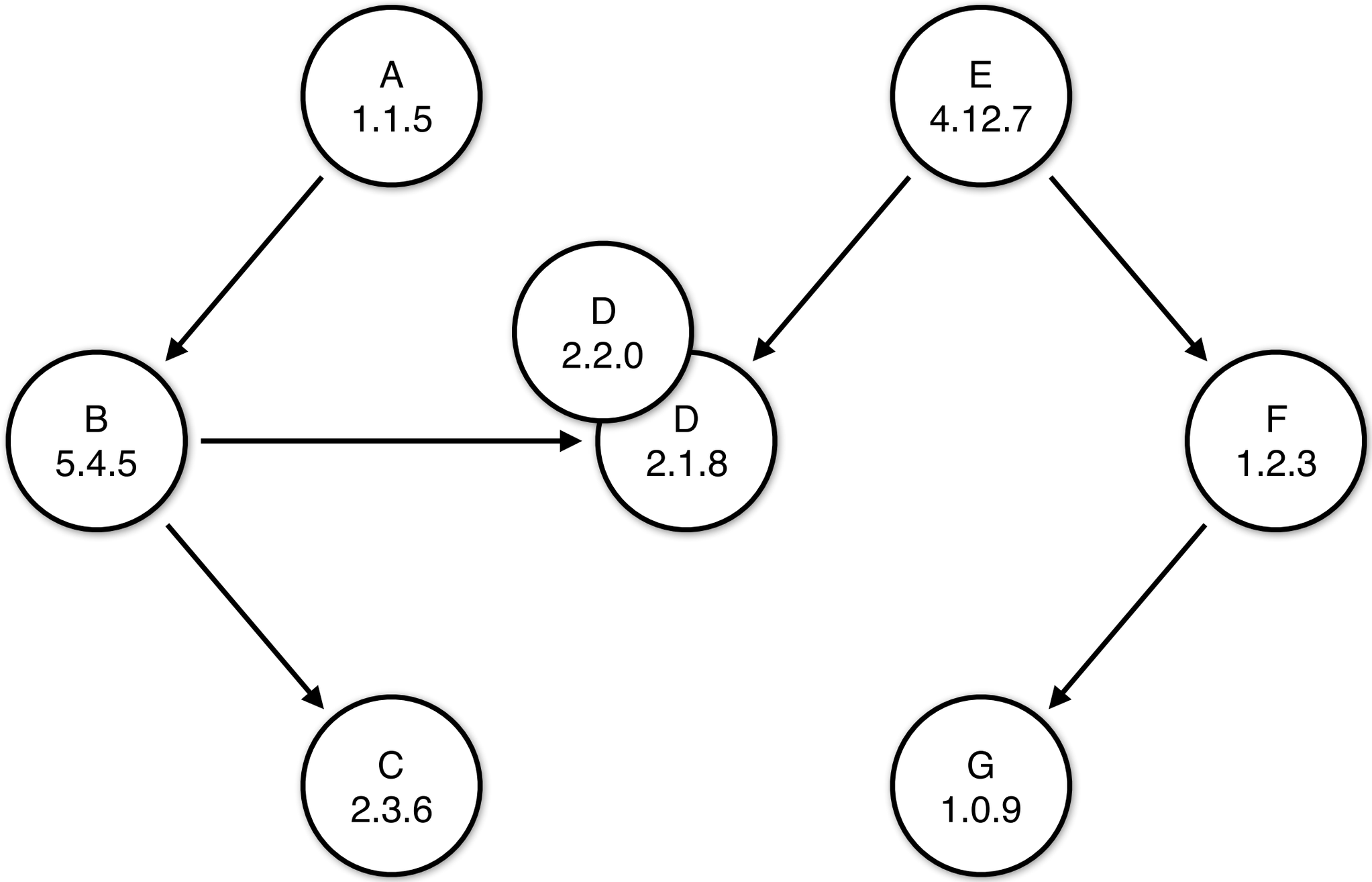

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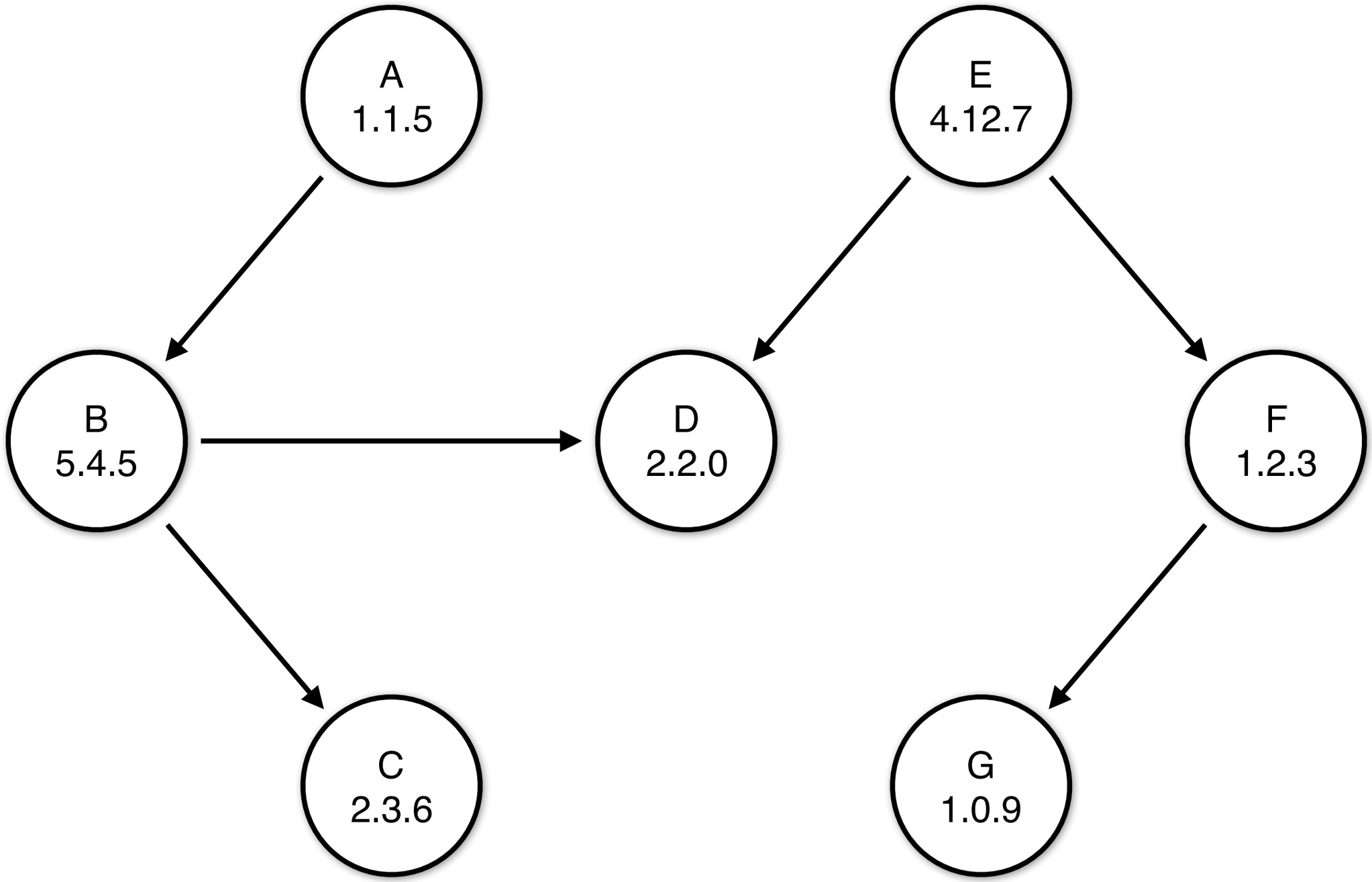

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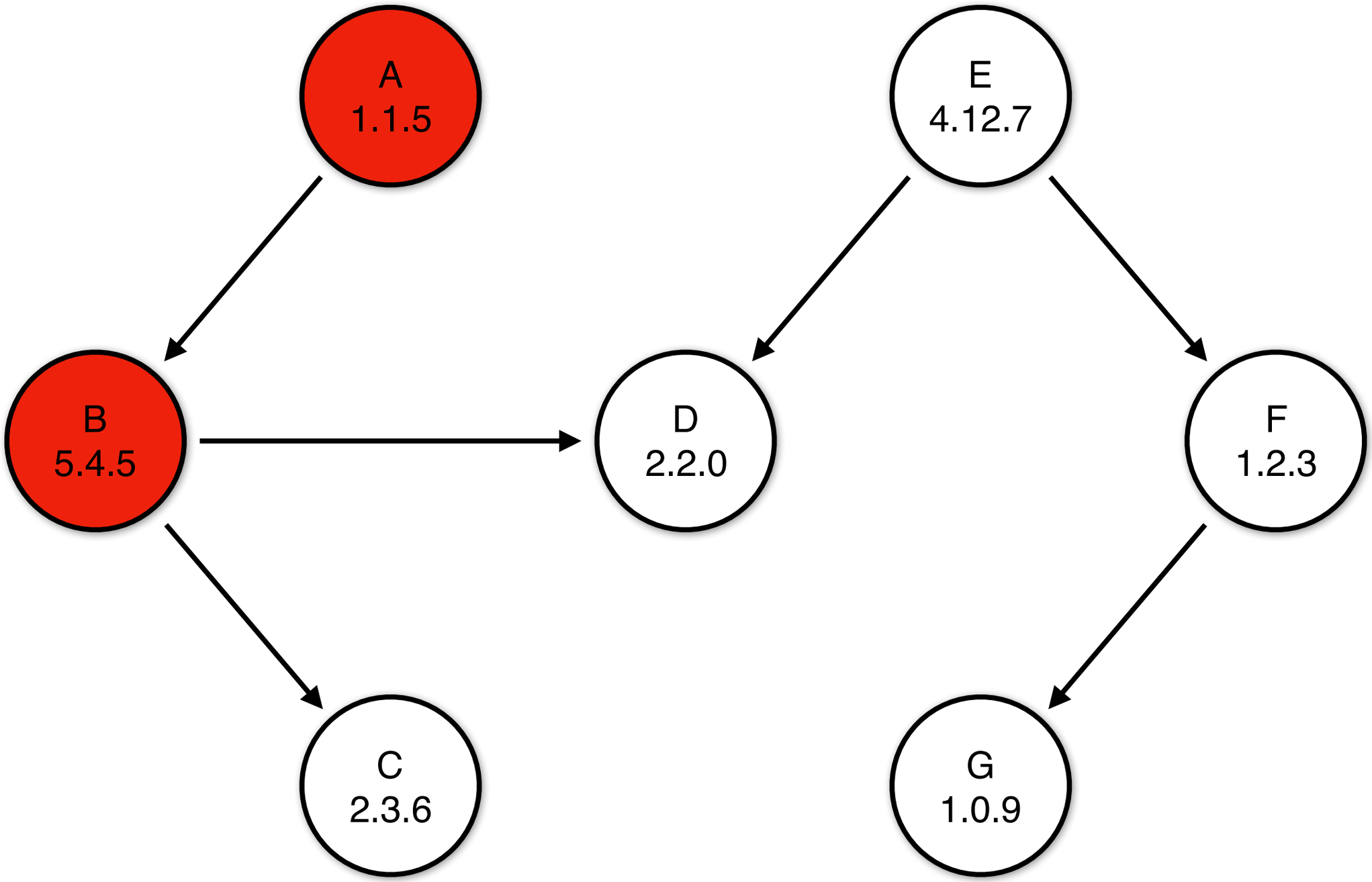
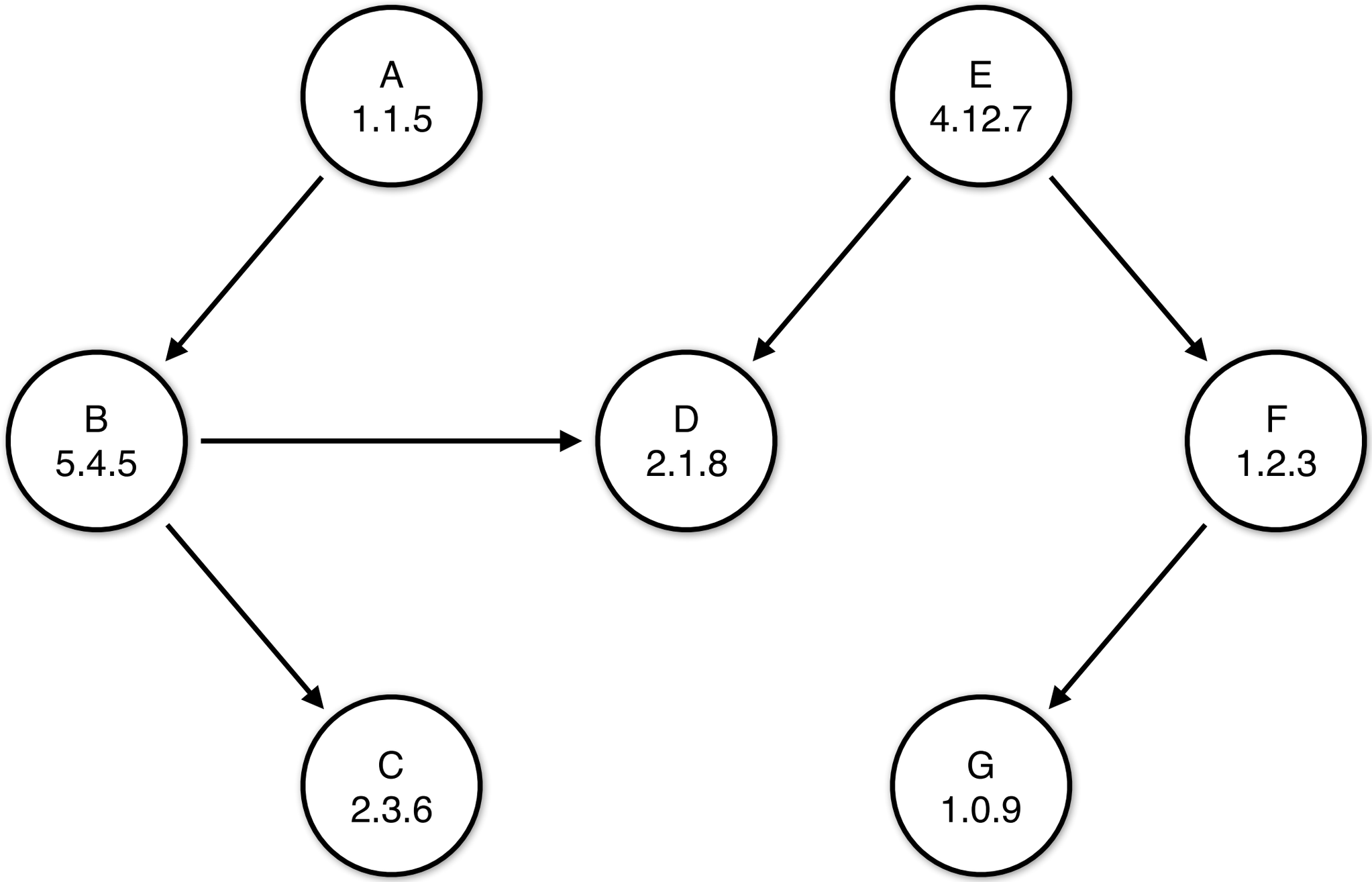


Immutable deployments



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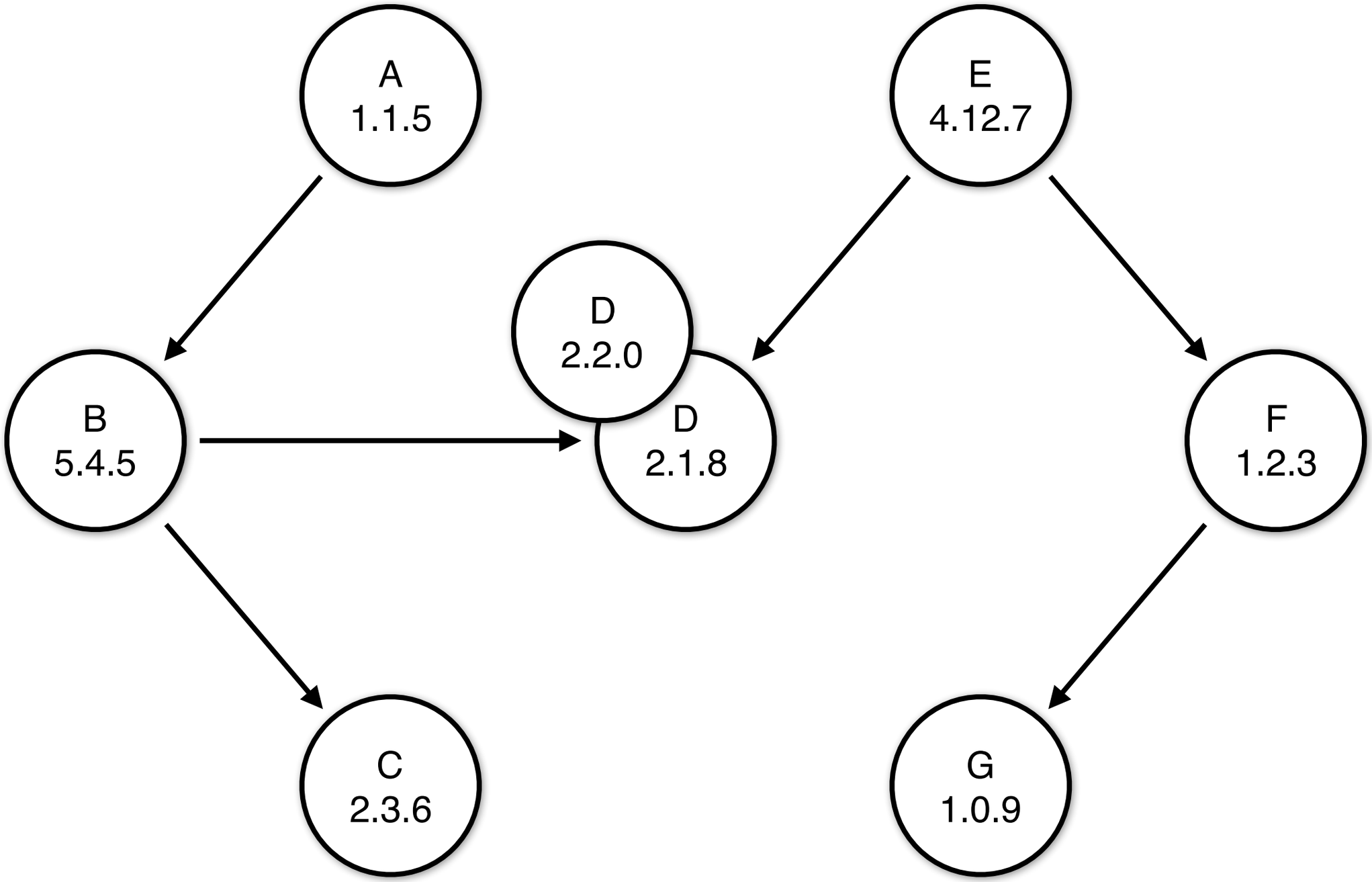

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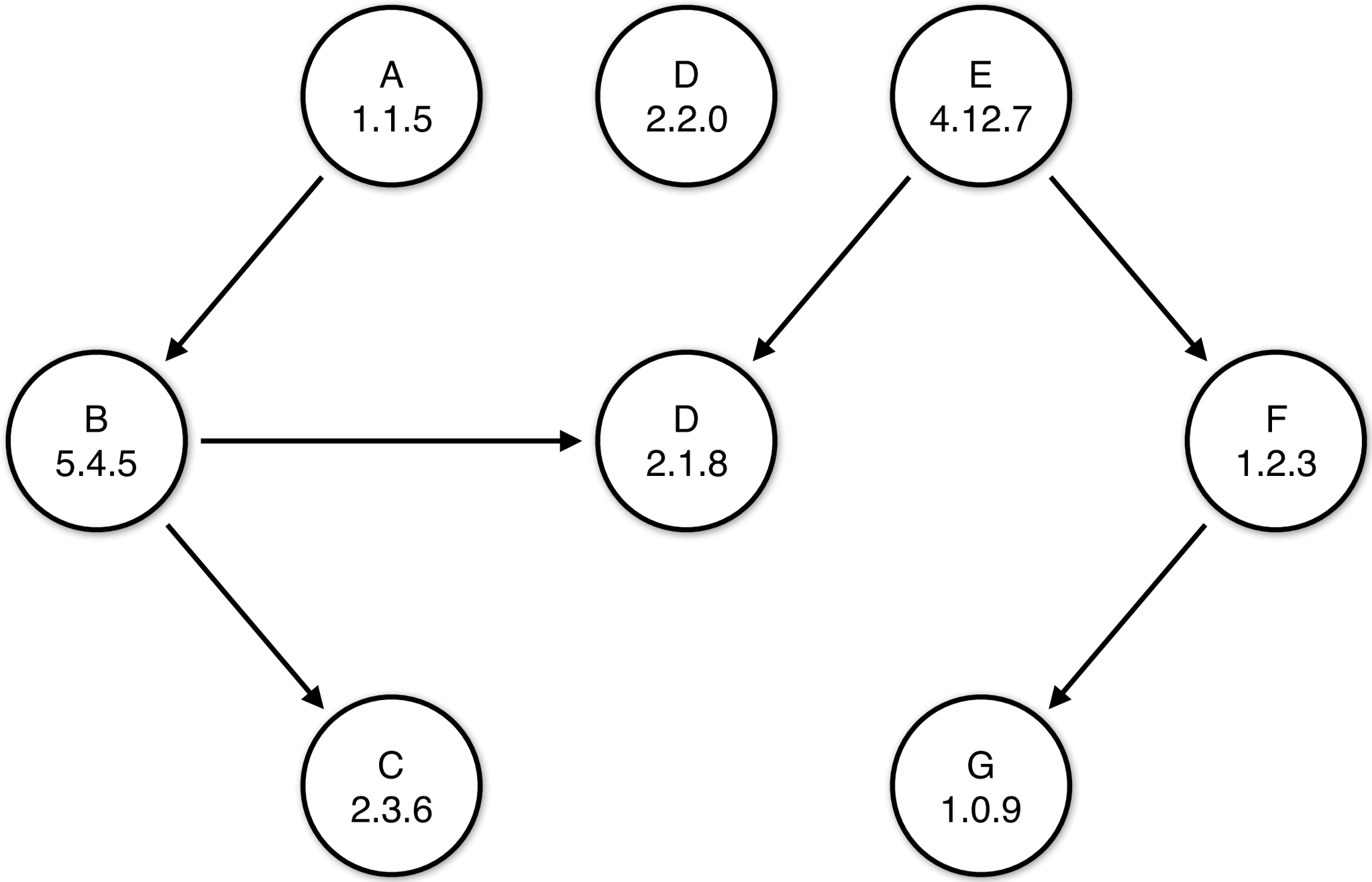

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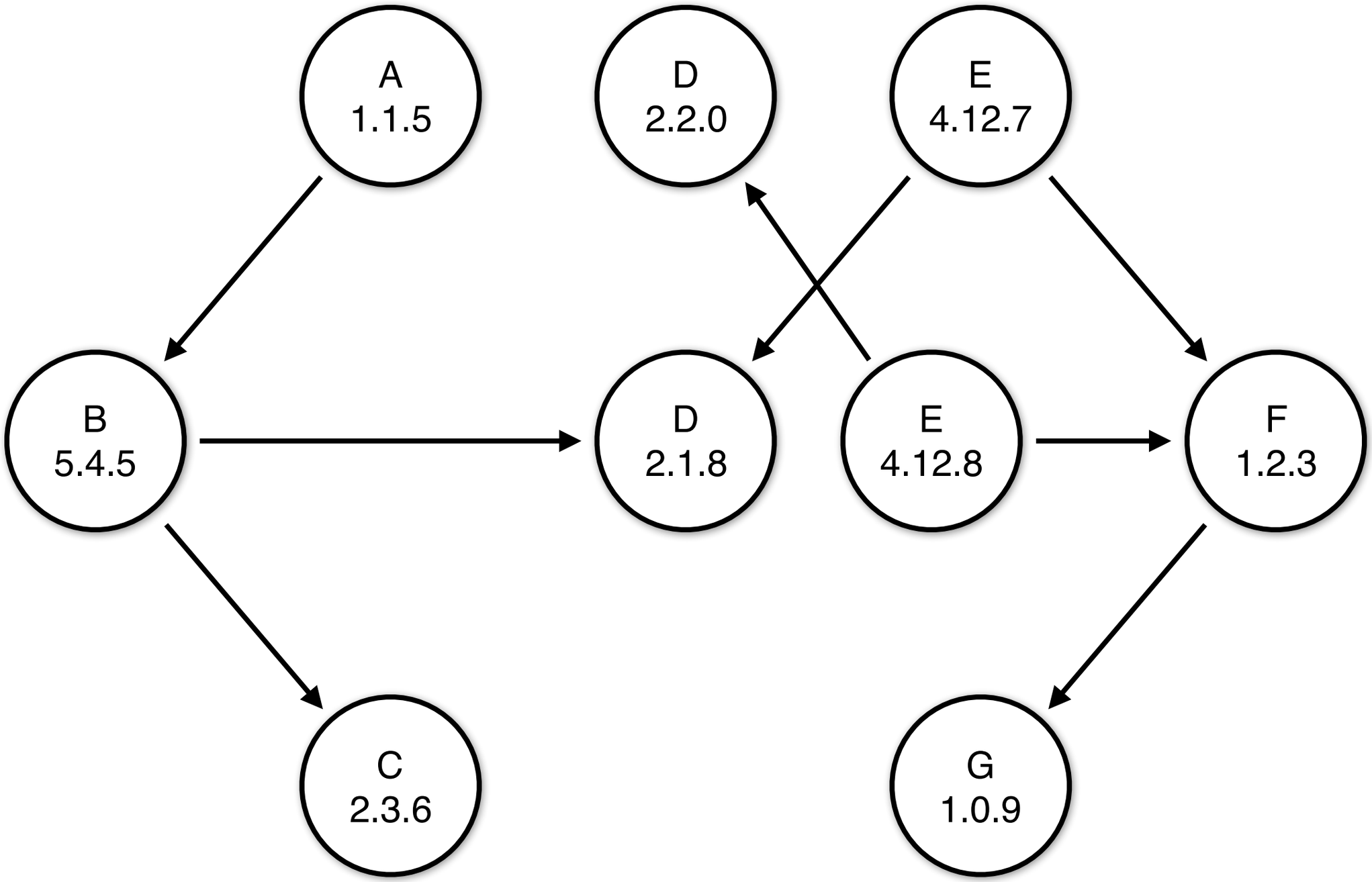

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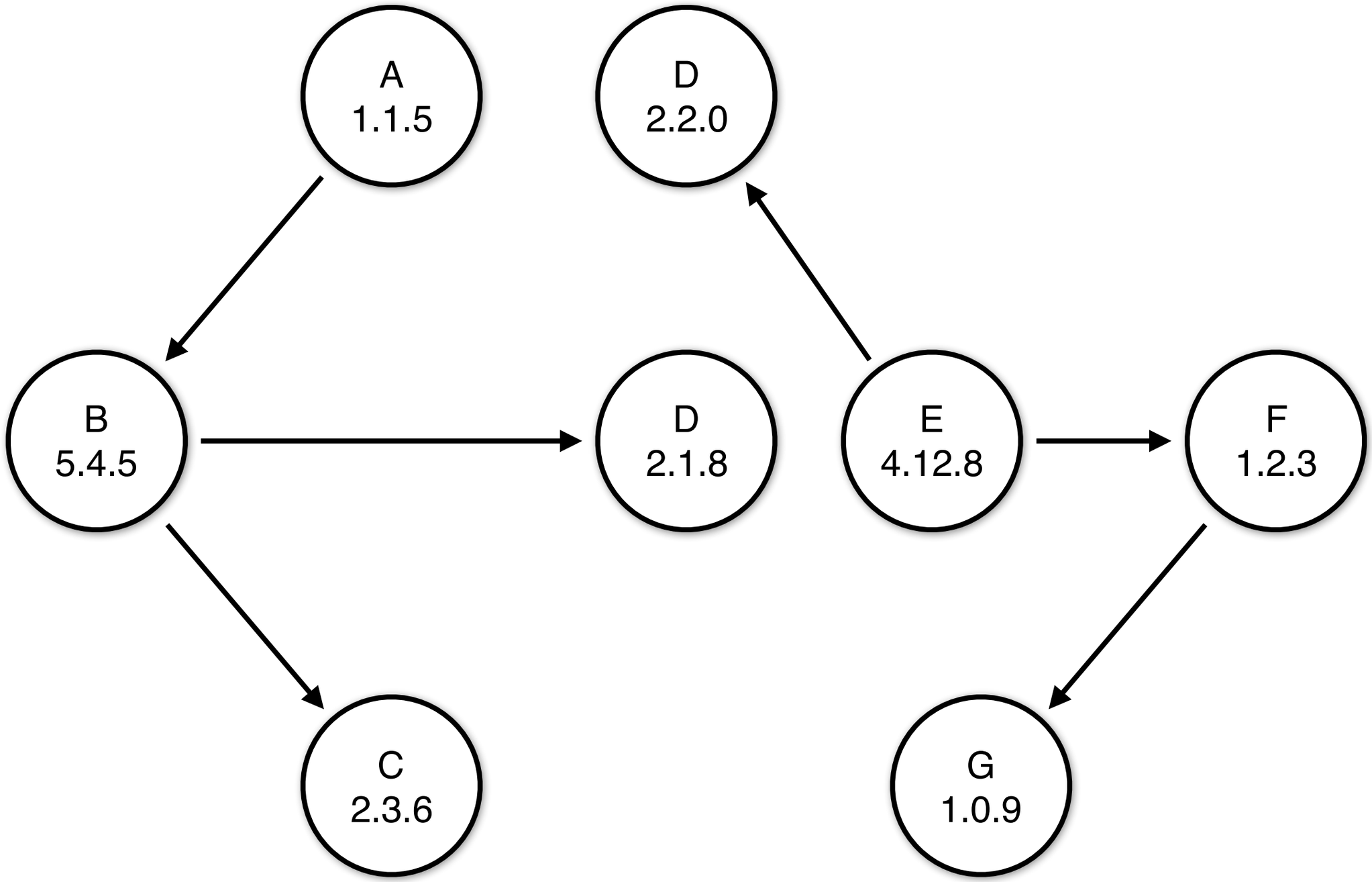

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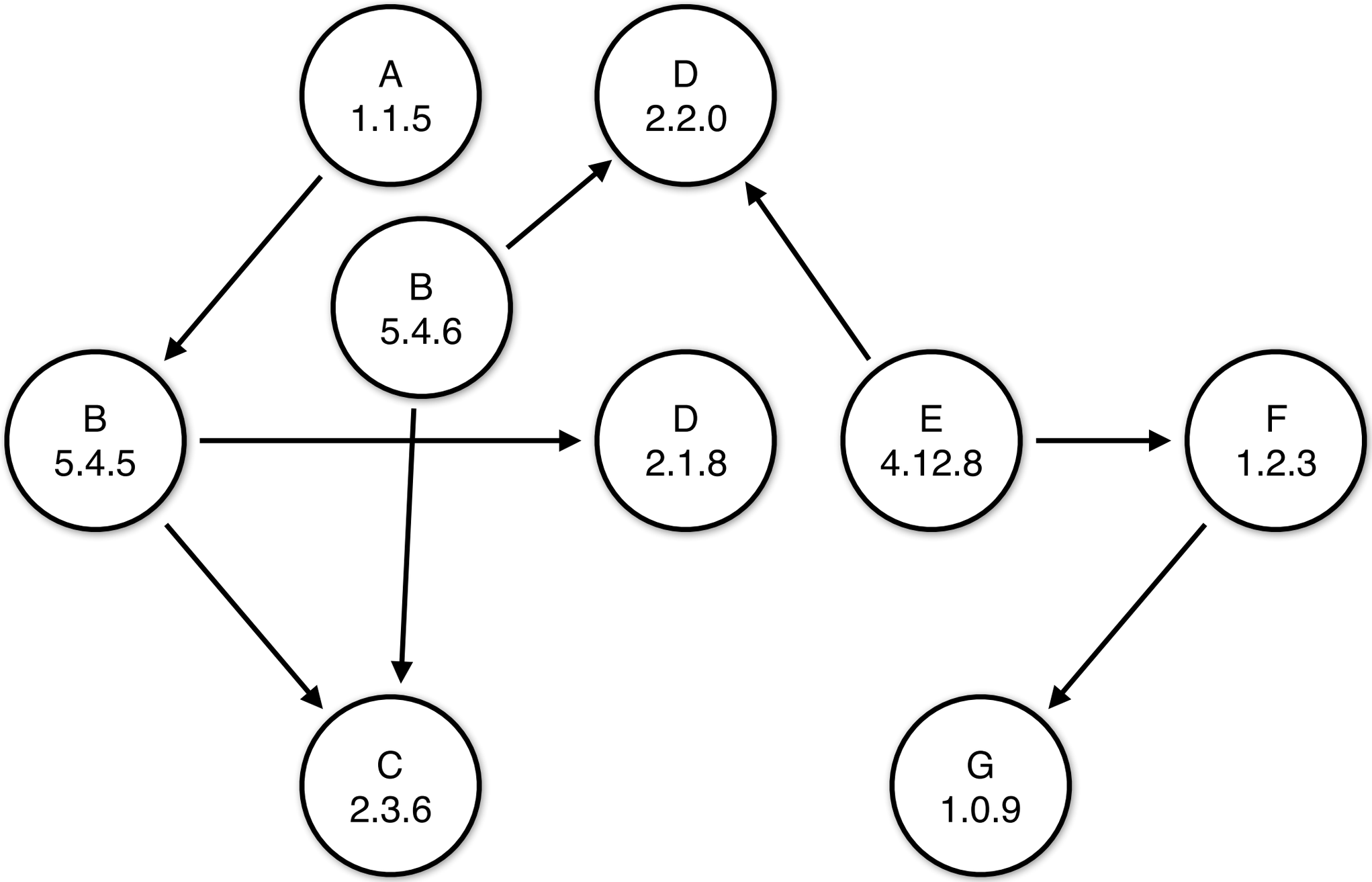

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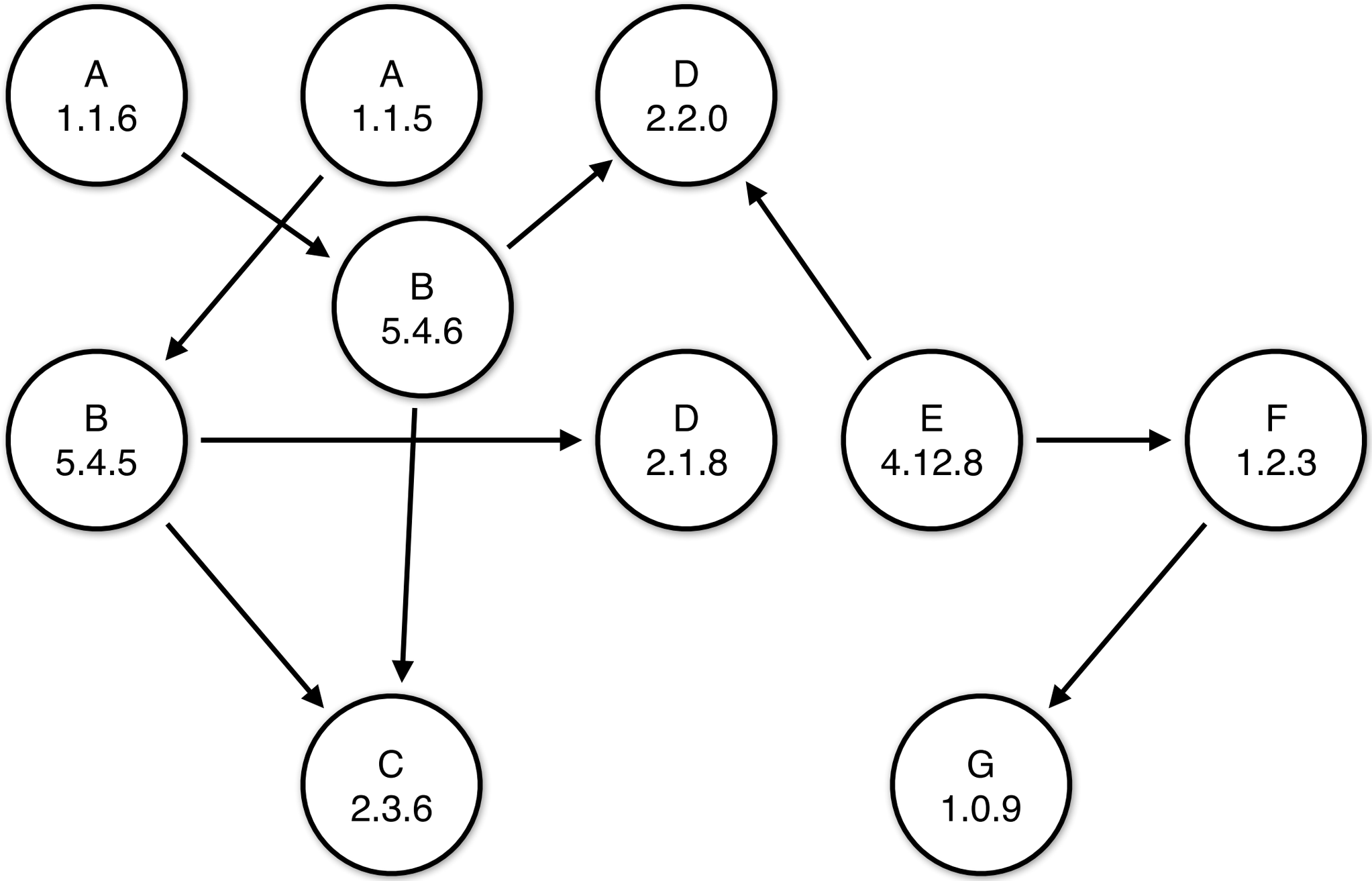

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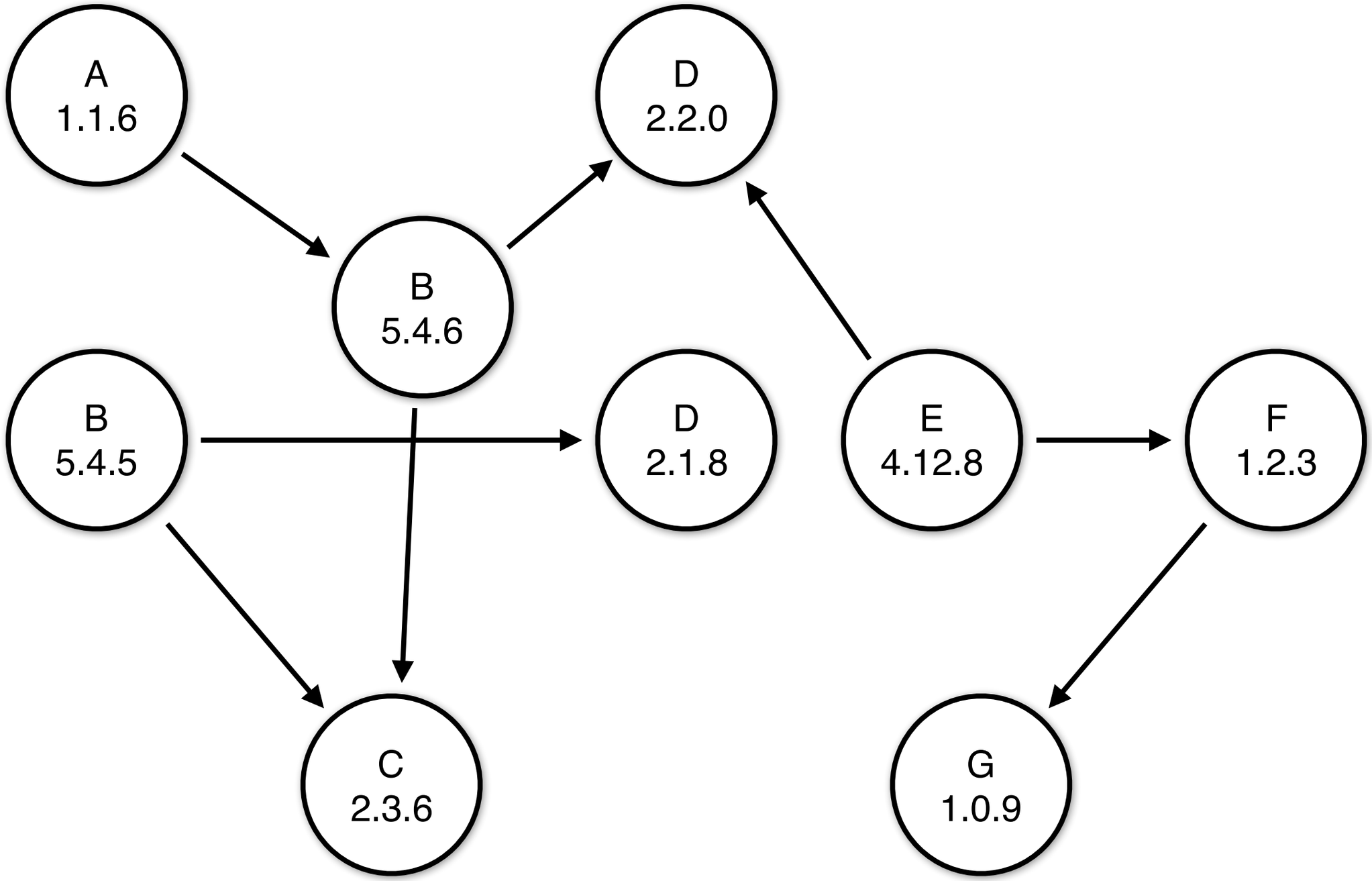

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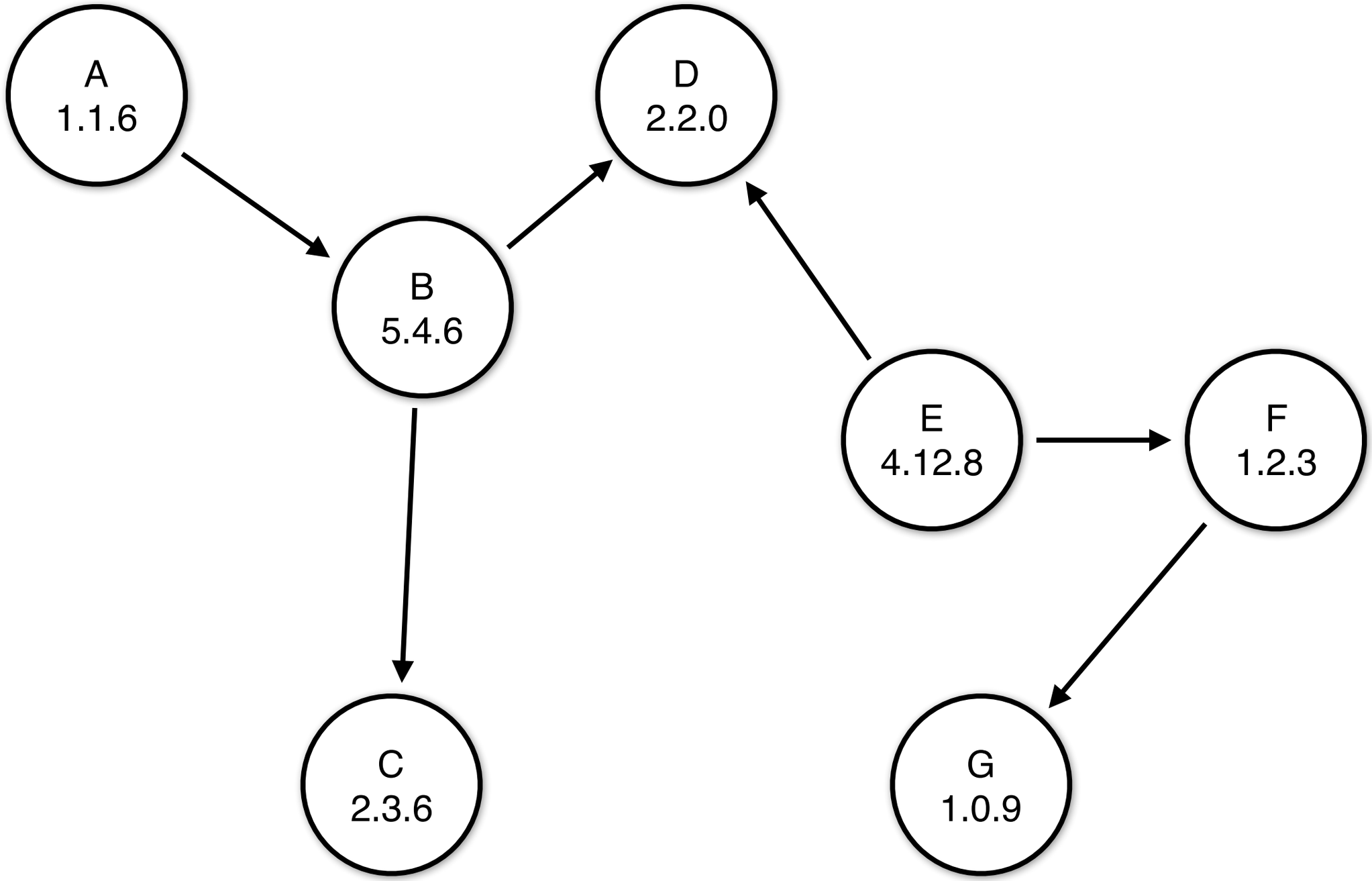
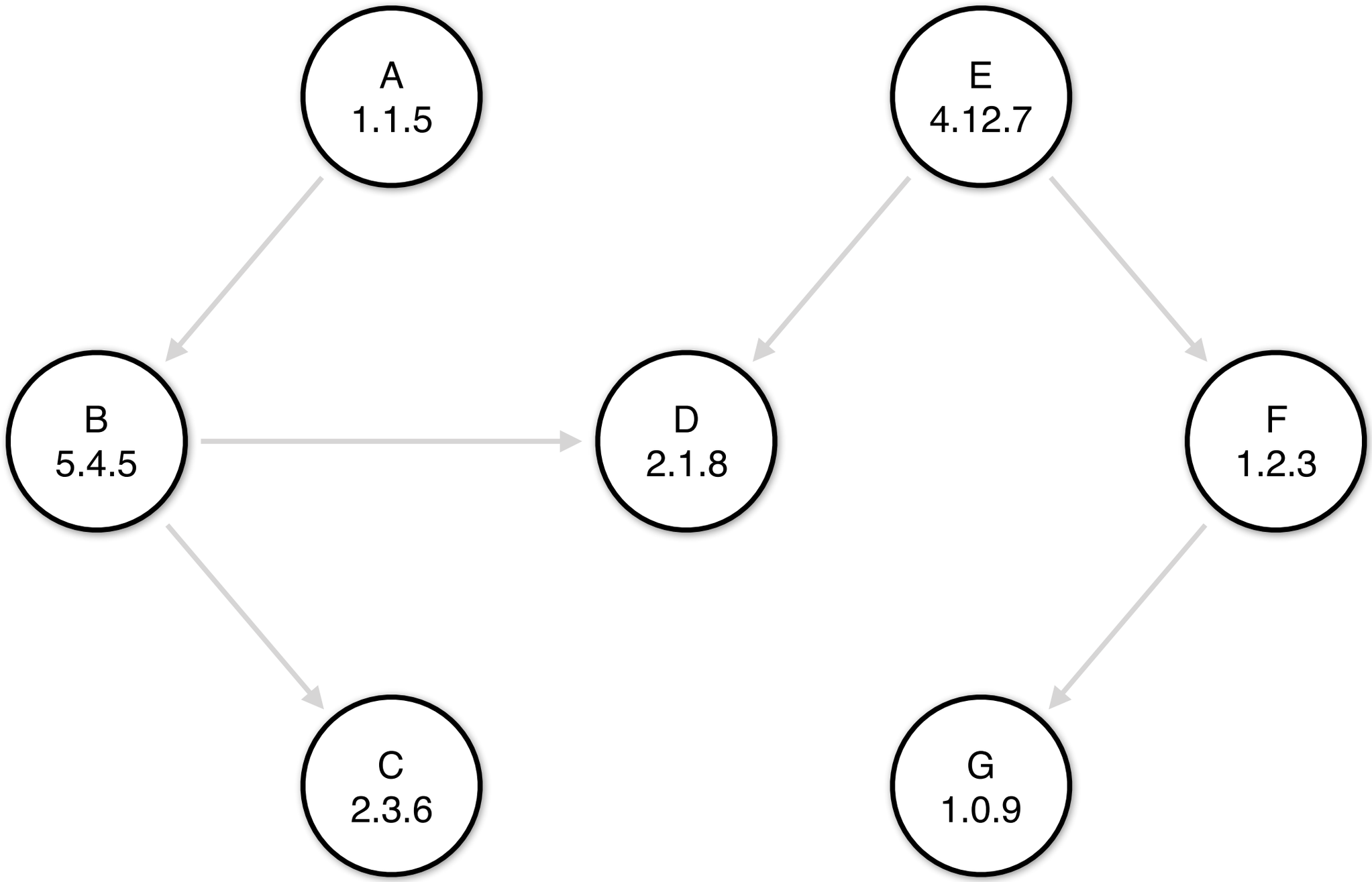


Reify the call graph



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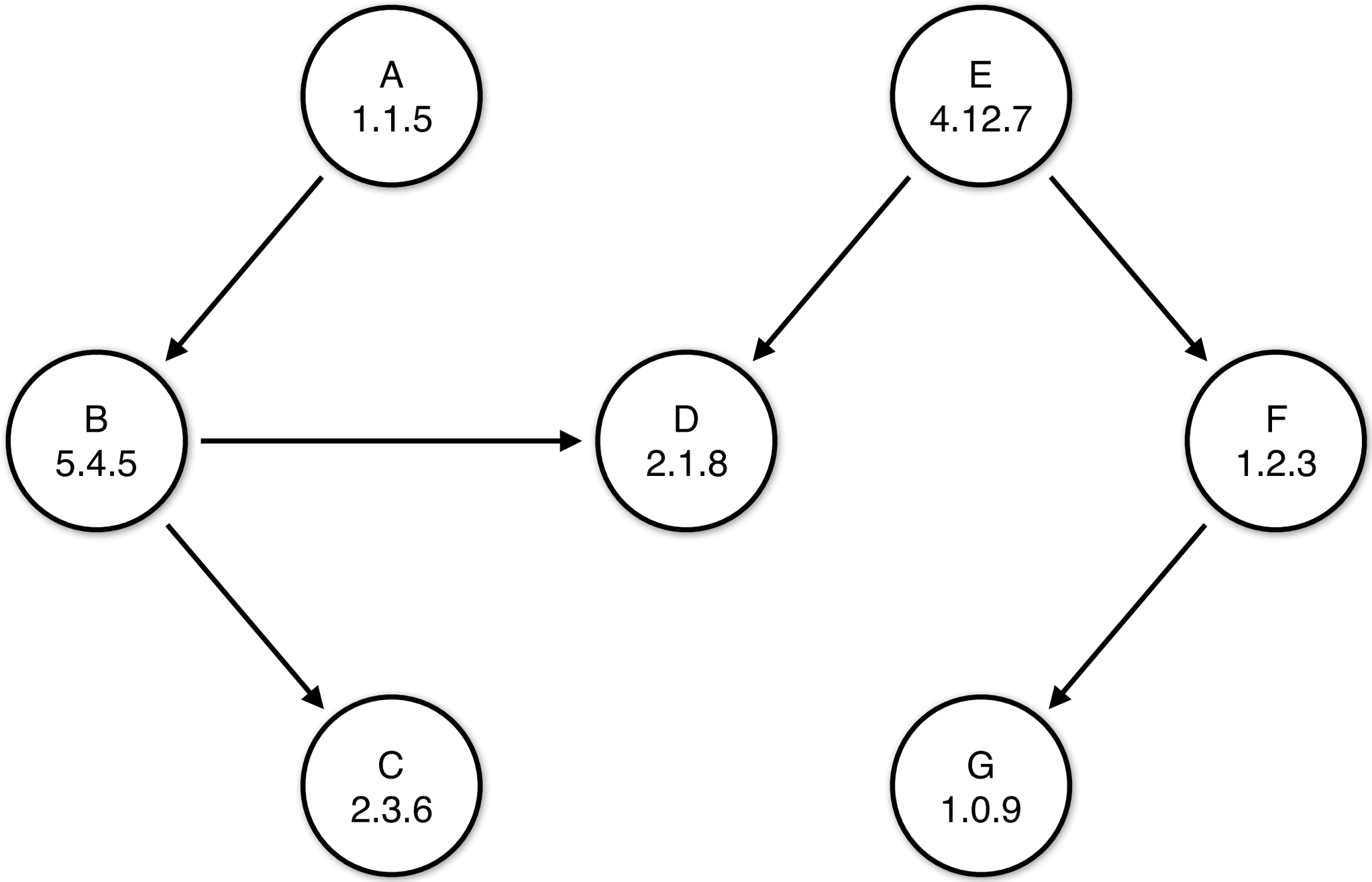

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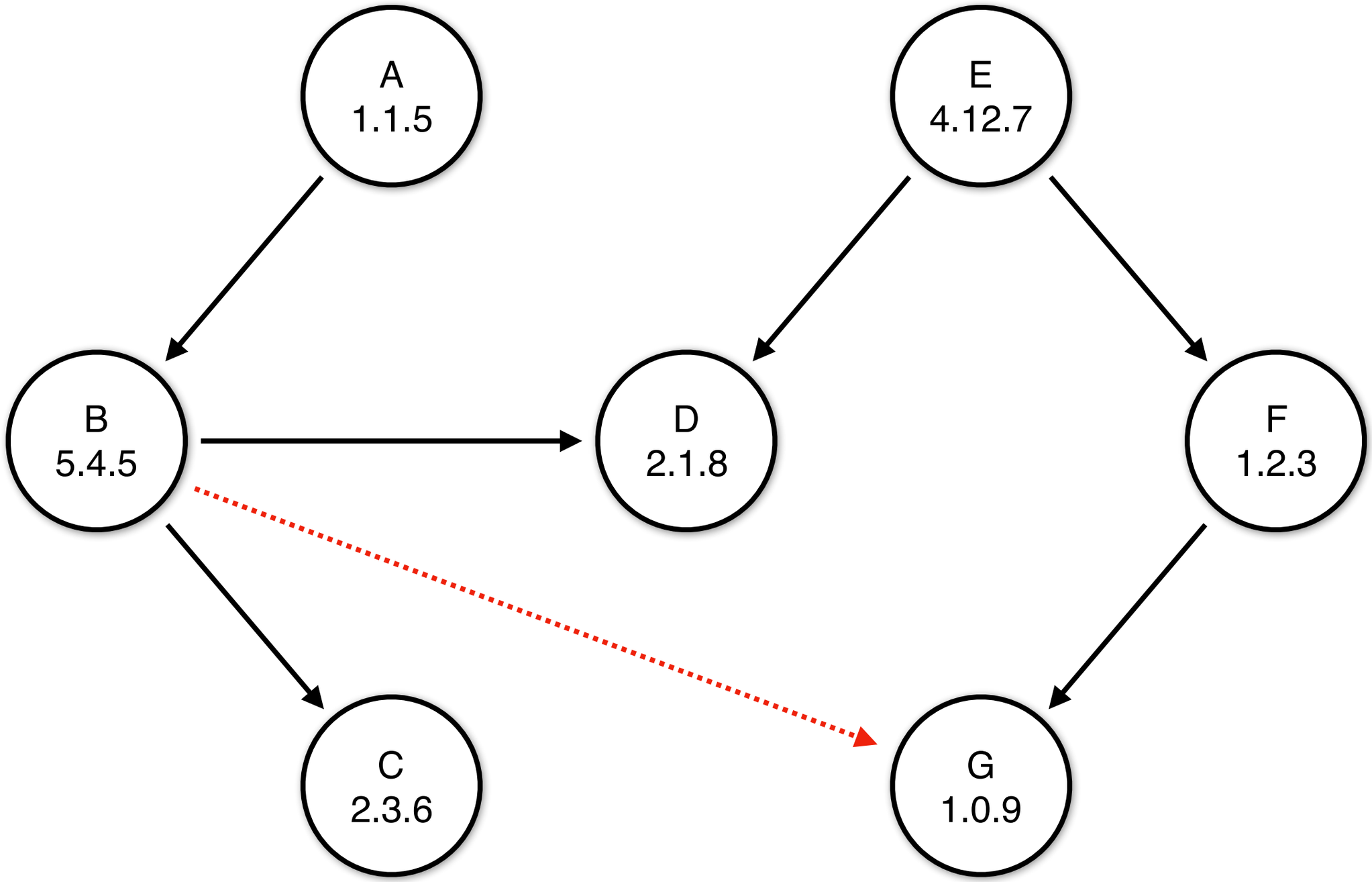

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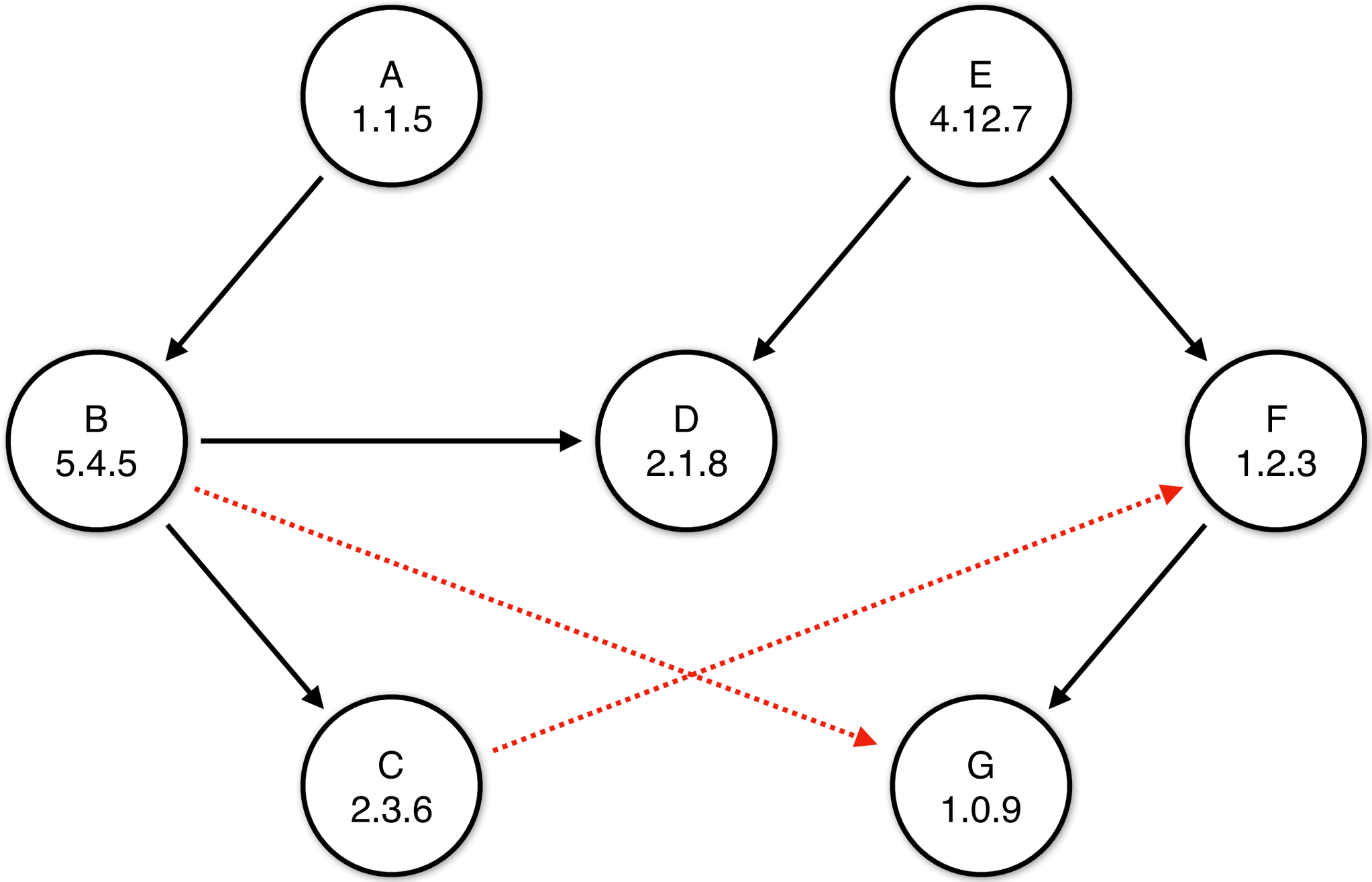

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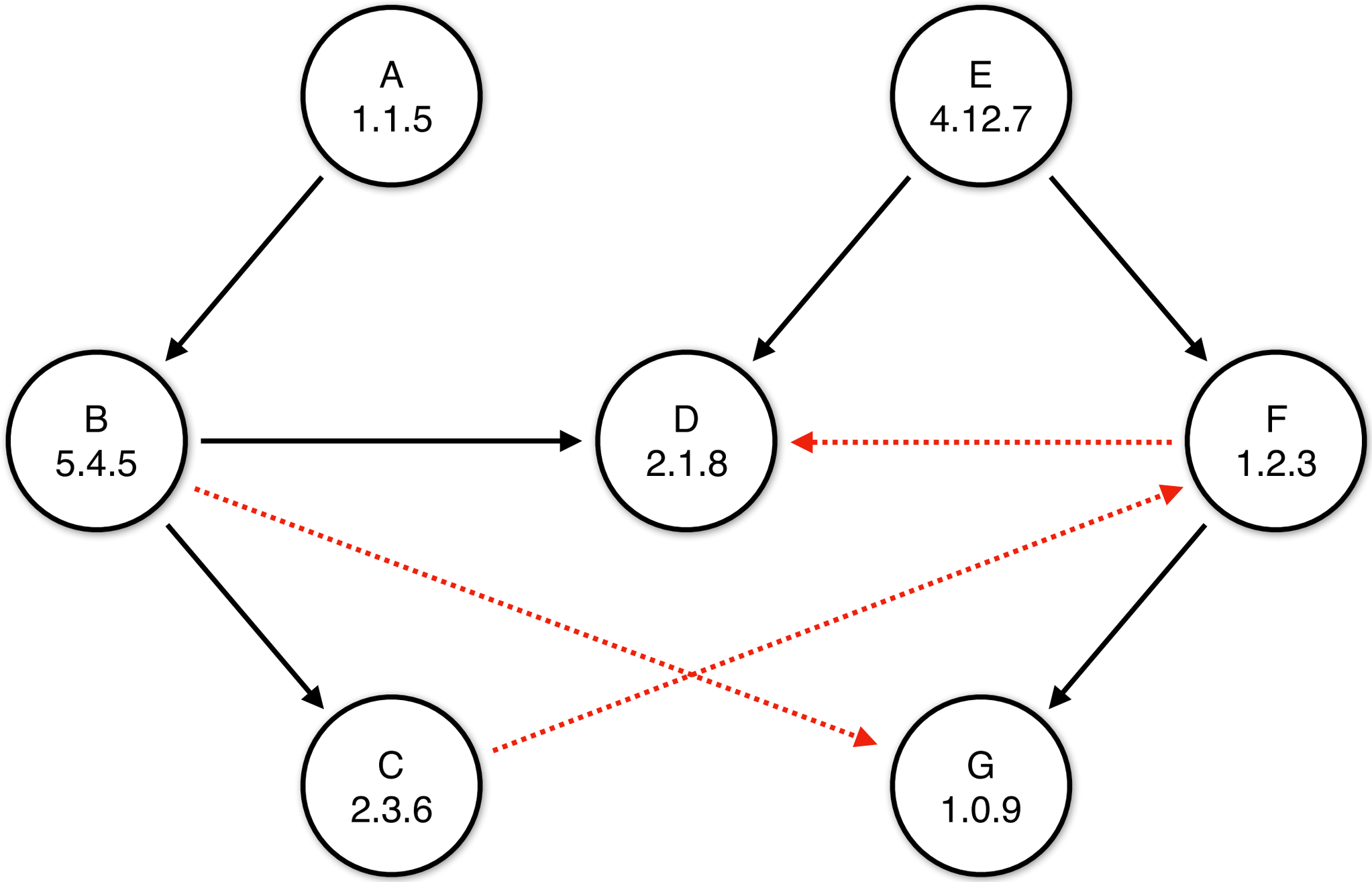

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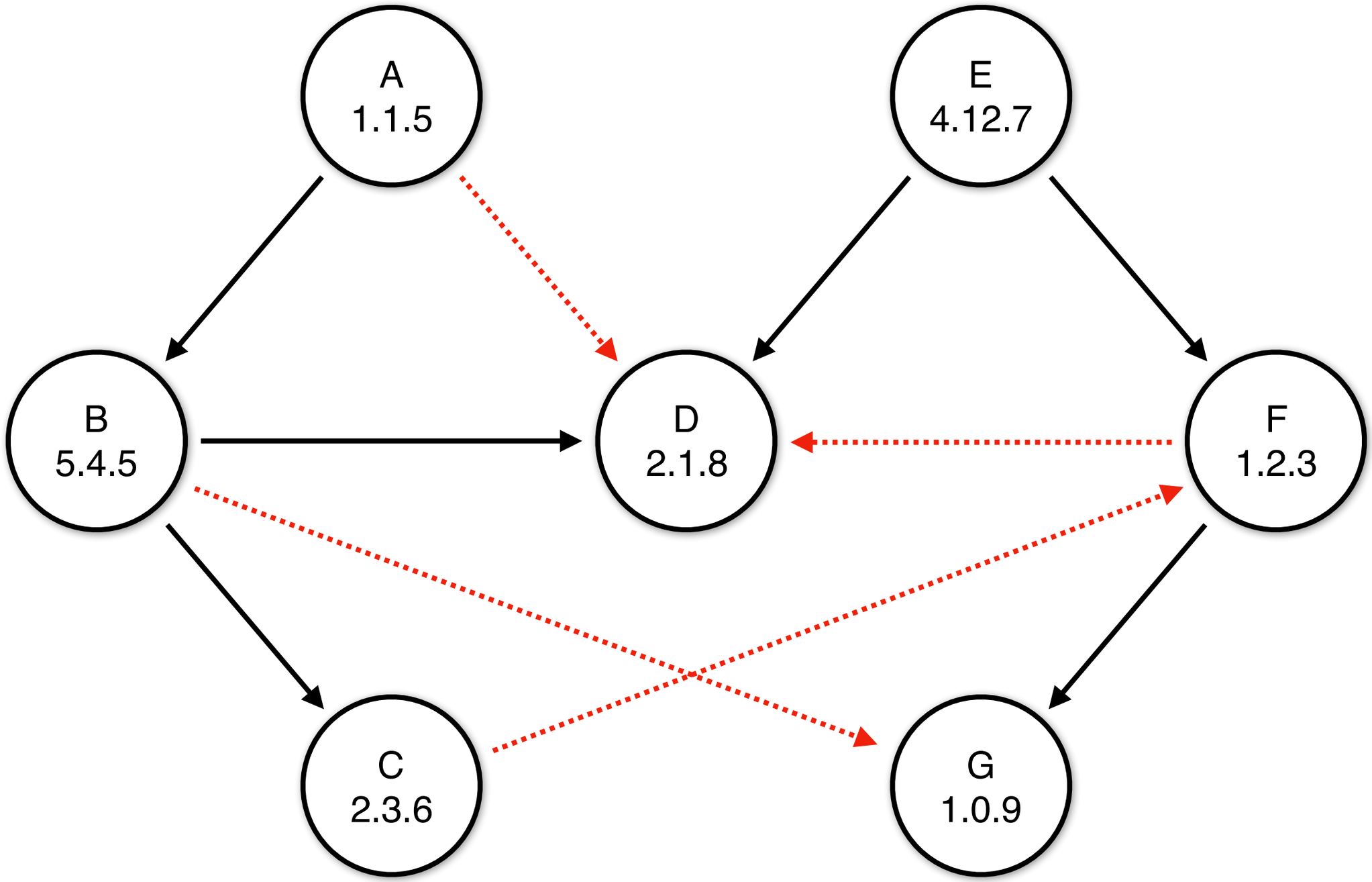


N
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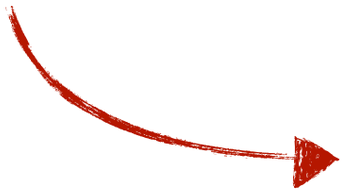
```yaml
name: foo
version: 0.3.19
output:
  kind: container
  image: units/foo:0.3.19
```

```
                                    ption of foo
        - default->9000/http
      dependencies:
        - ref: bar@2.1
        - ref: baz@2.3

plans:
  - name: default

namespaces:
  - name: production
    units:
      - ref: foo
        plans:
          - default
```

Name and version



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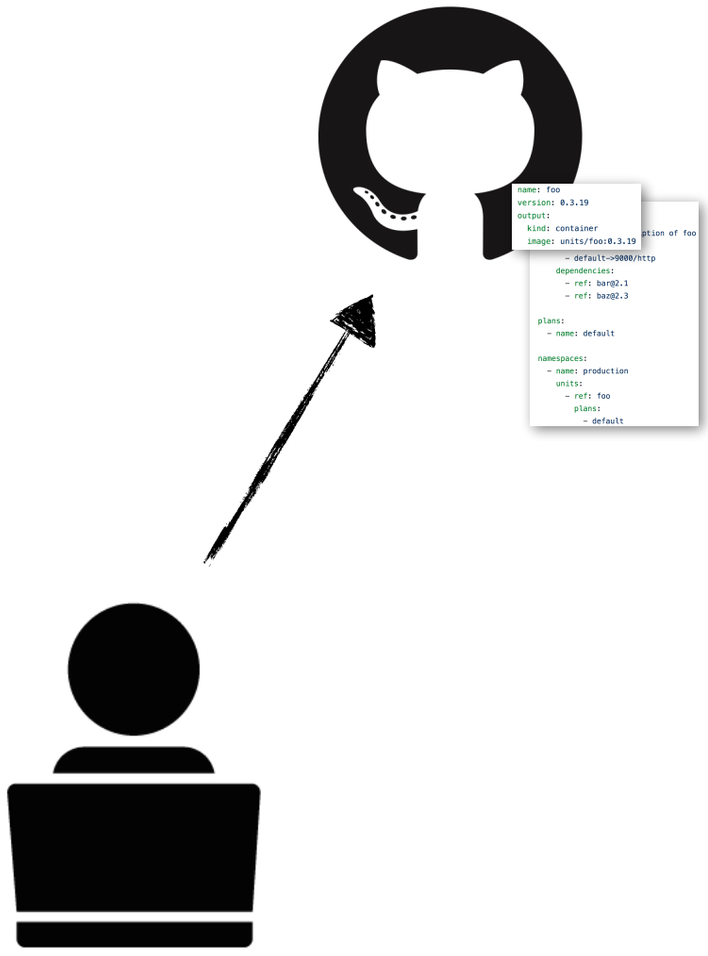
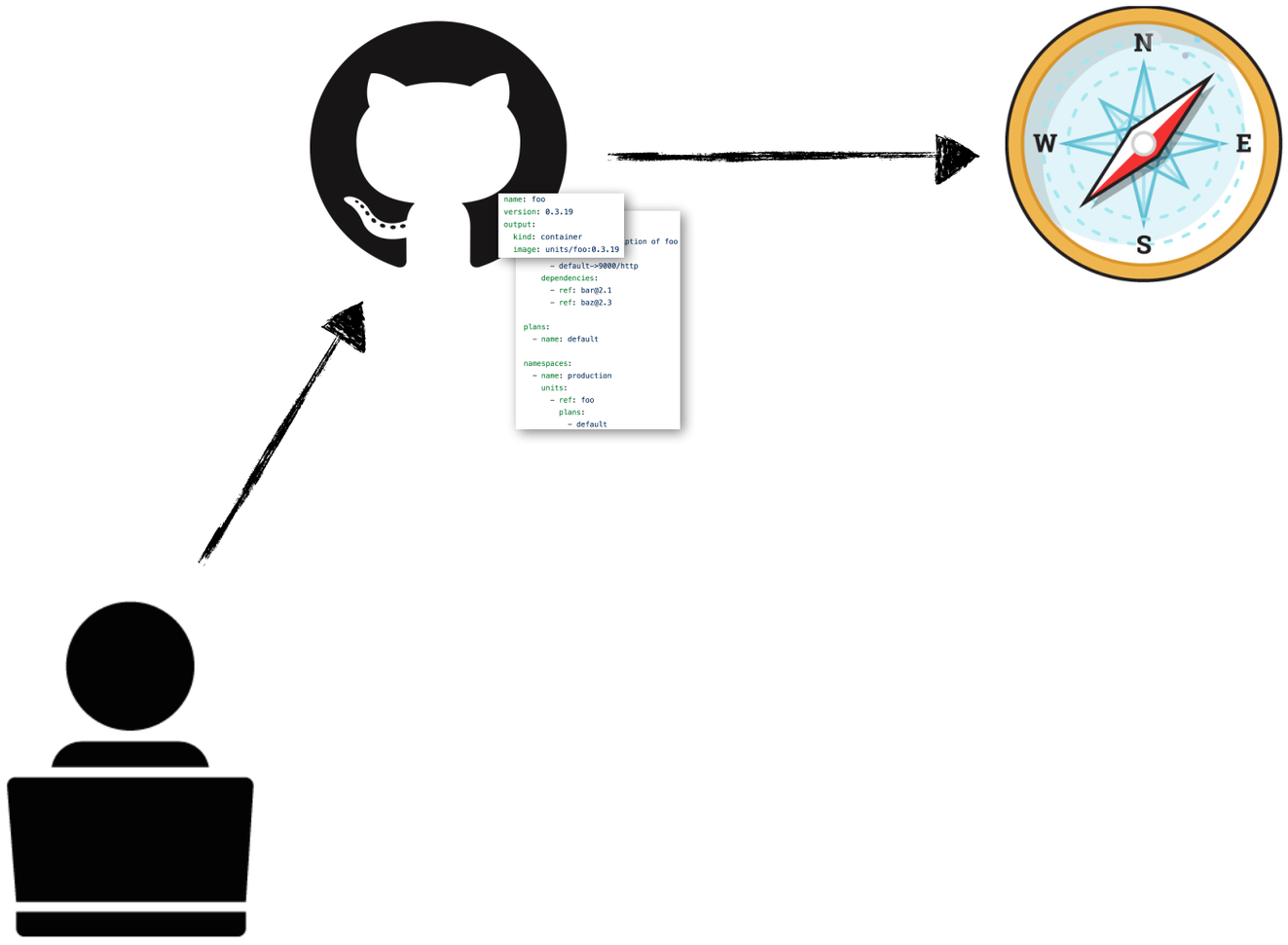
Dependencies

Nelson workflow



Nelson workflow



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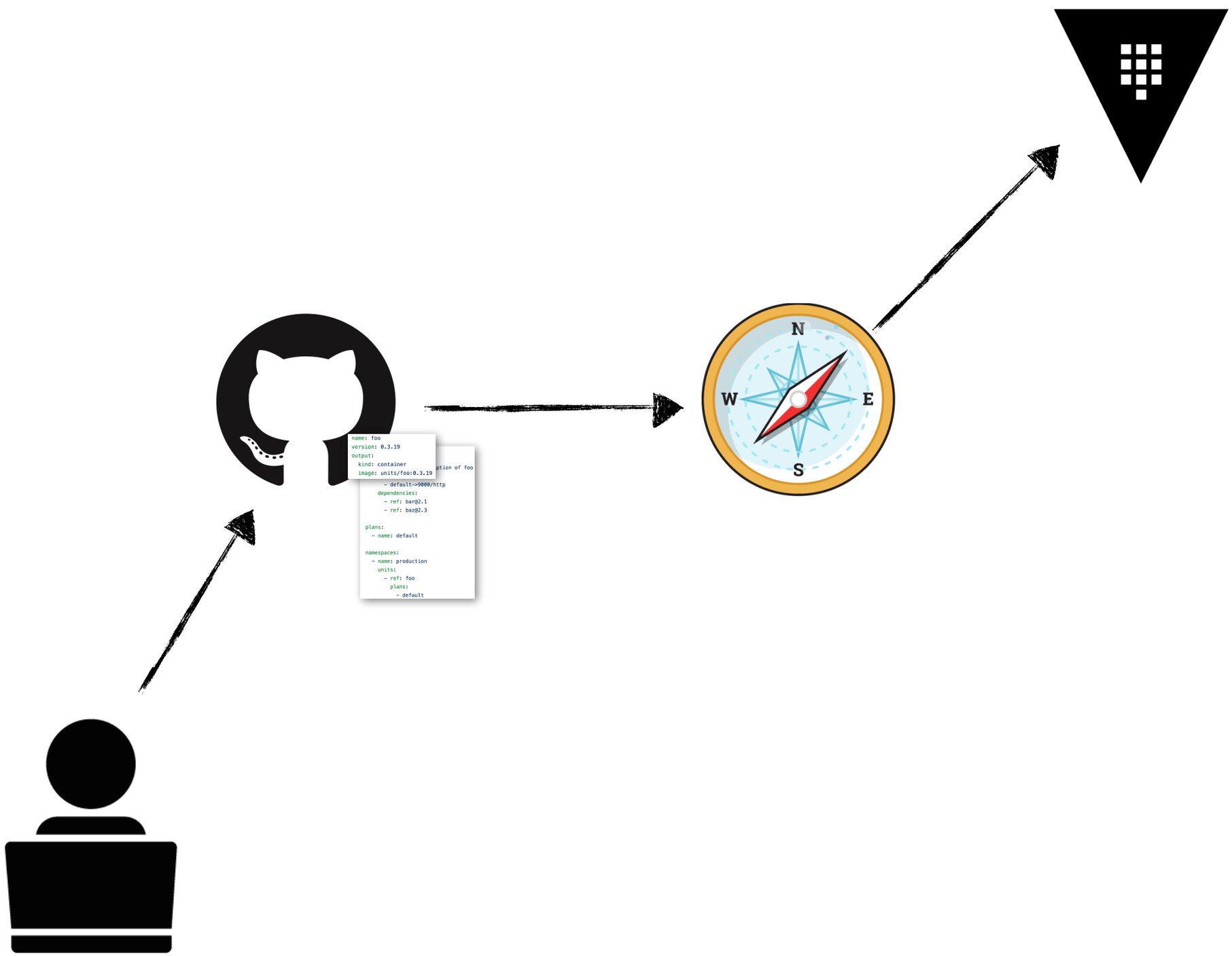

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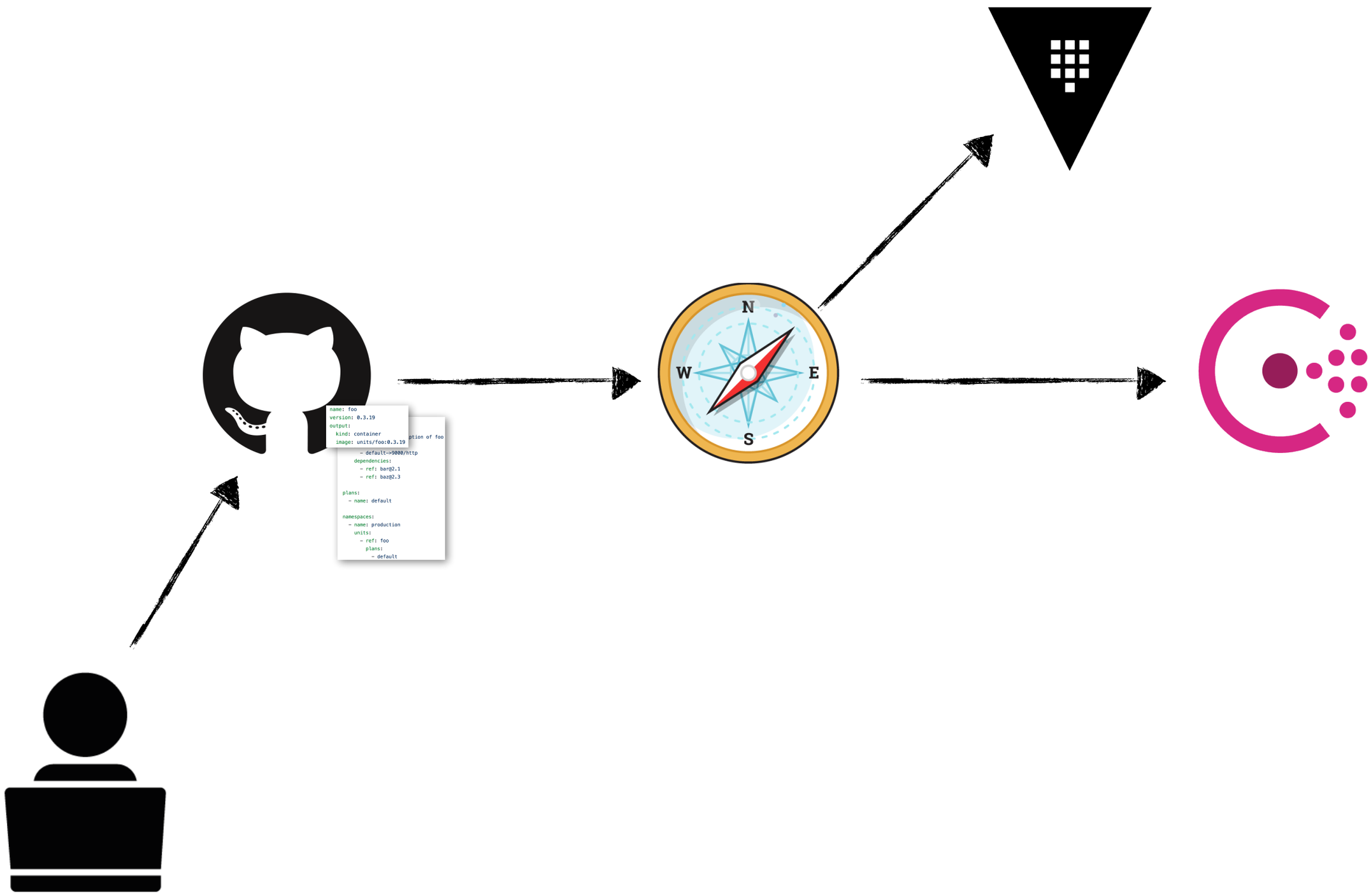

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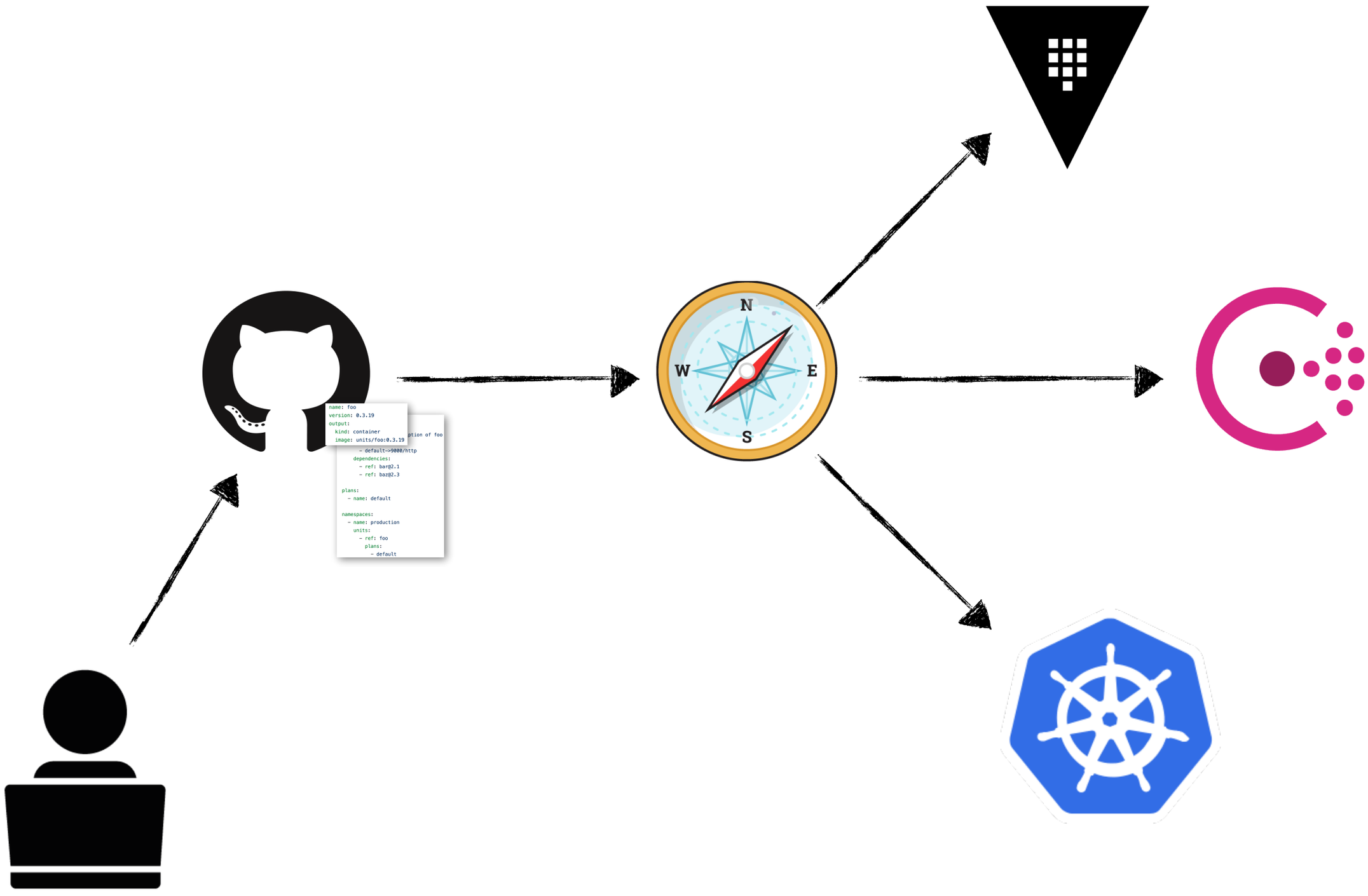
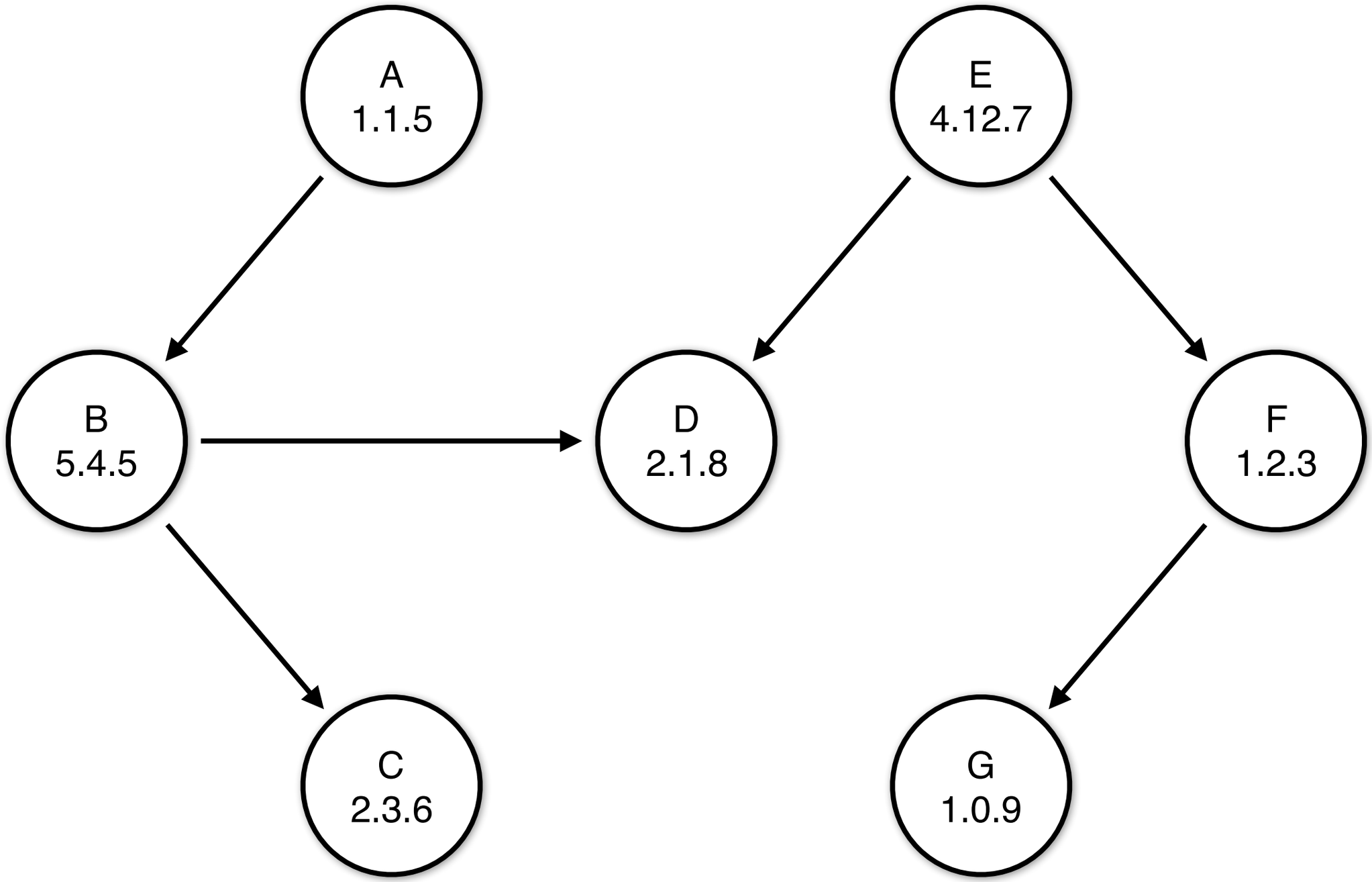


Graph management: traffic shifting



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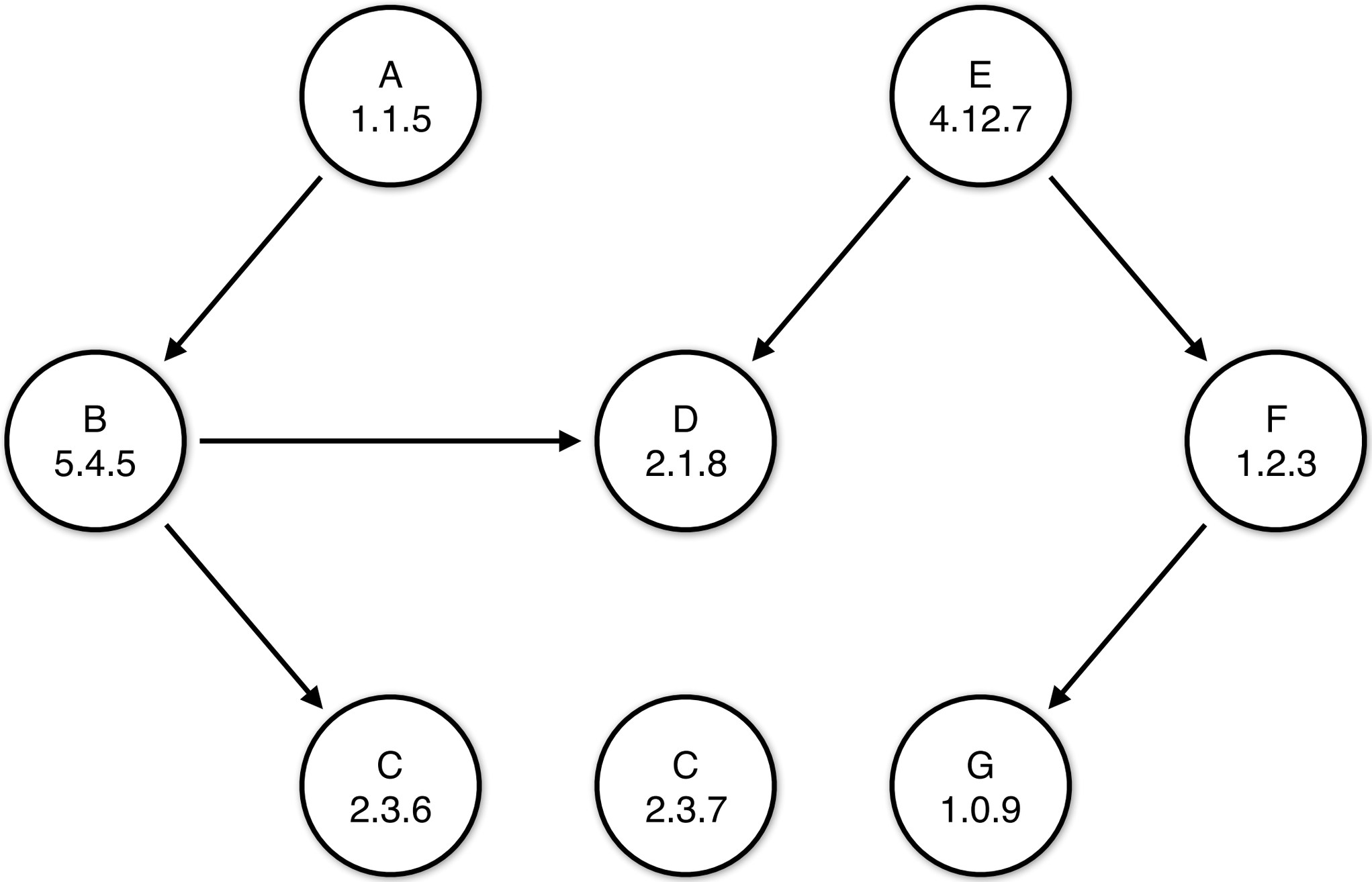

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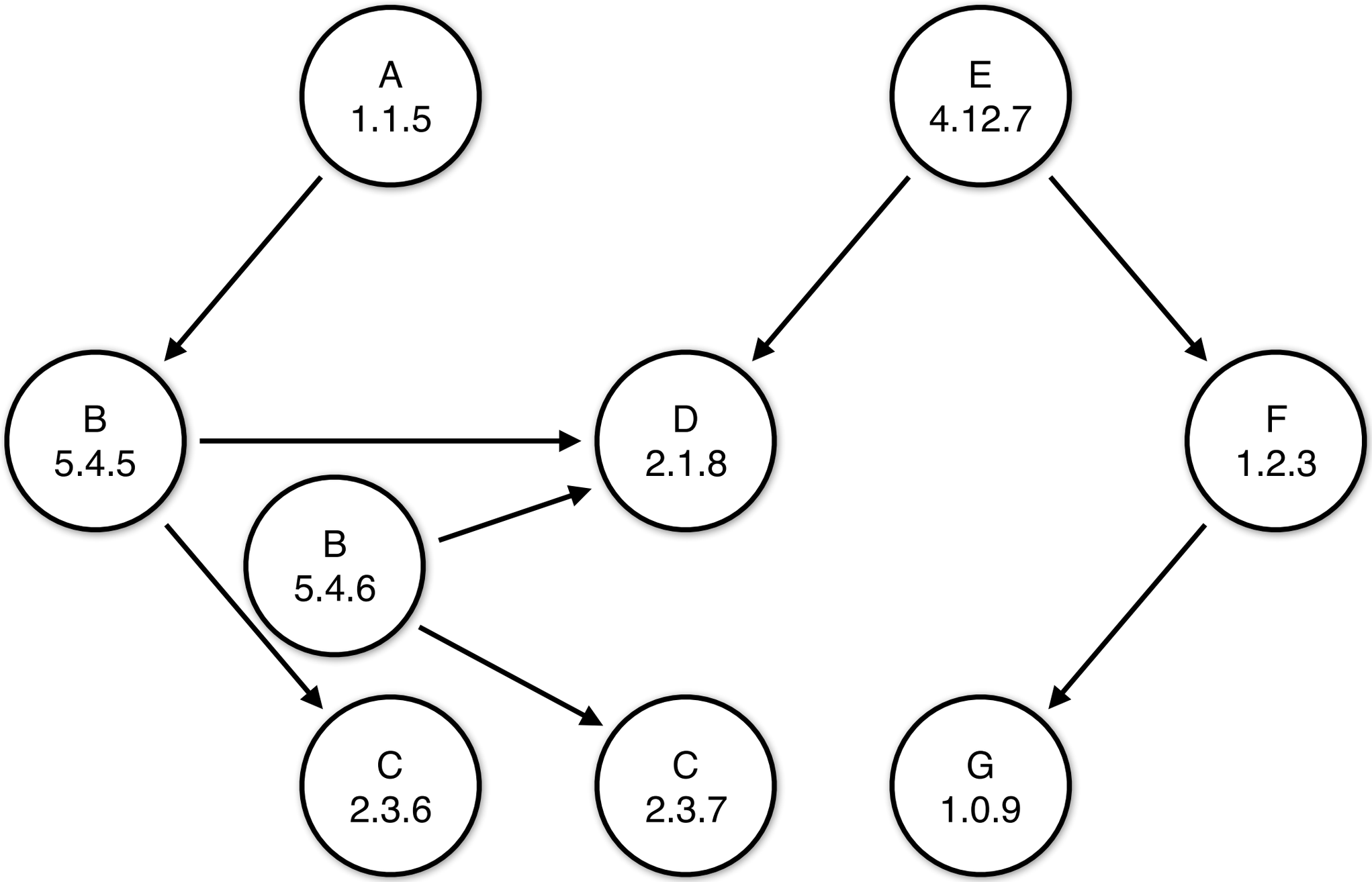

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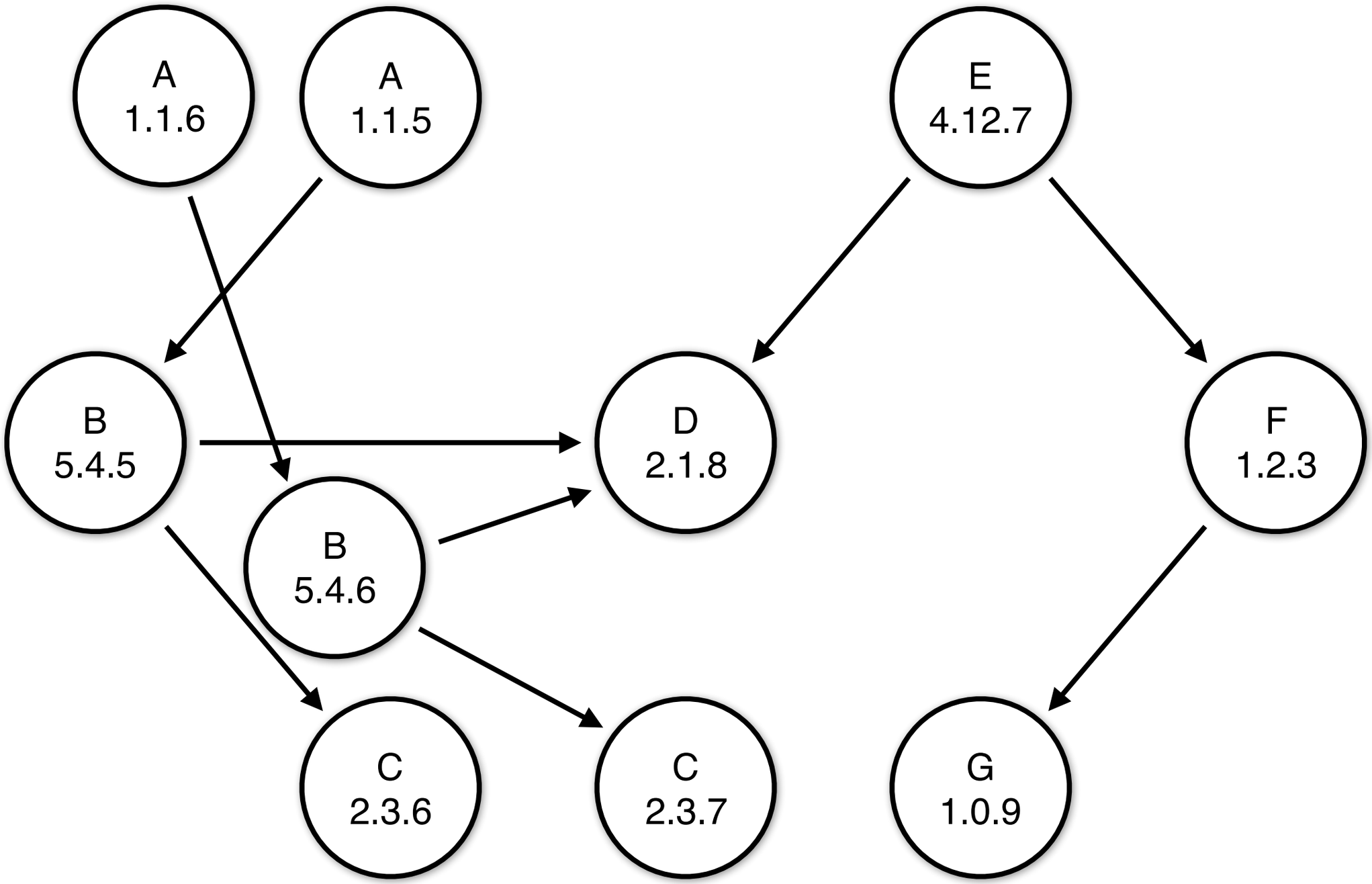

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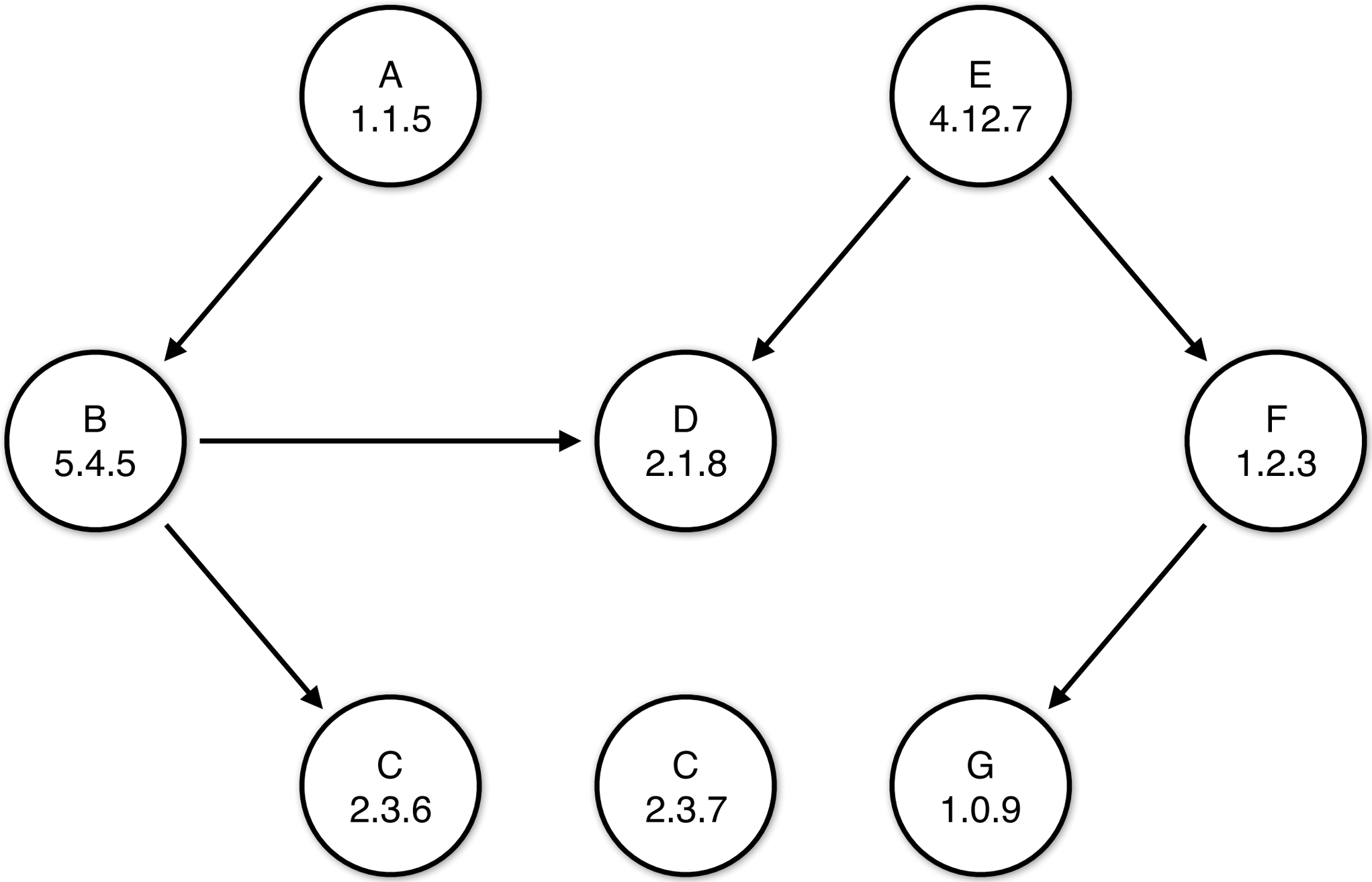

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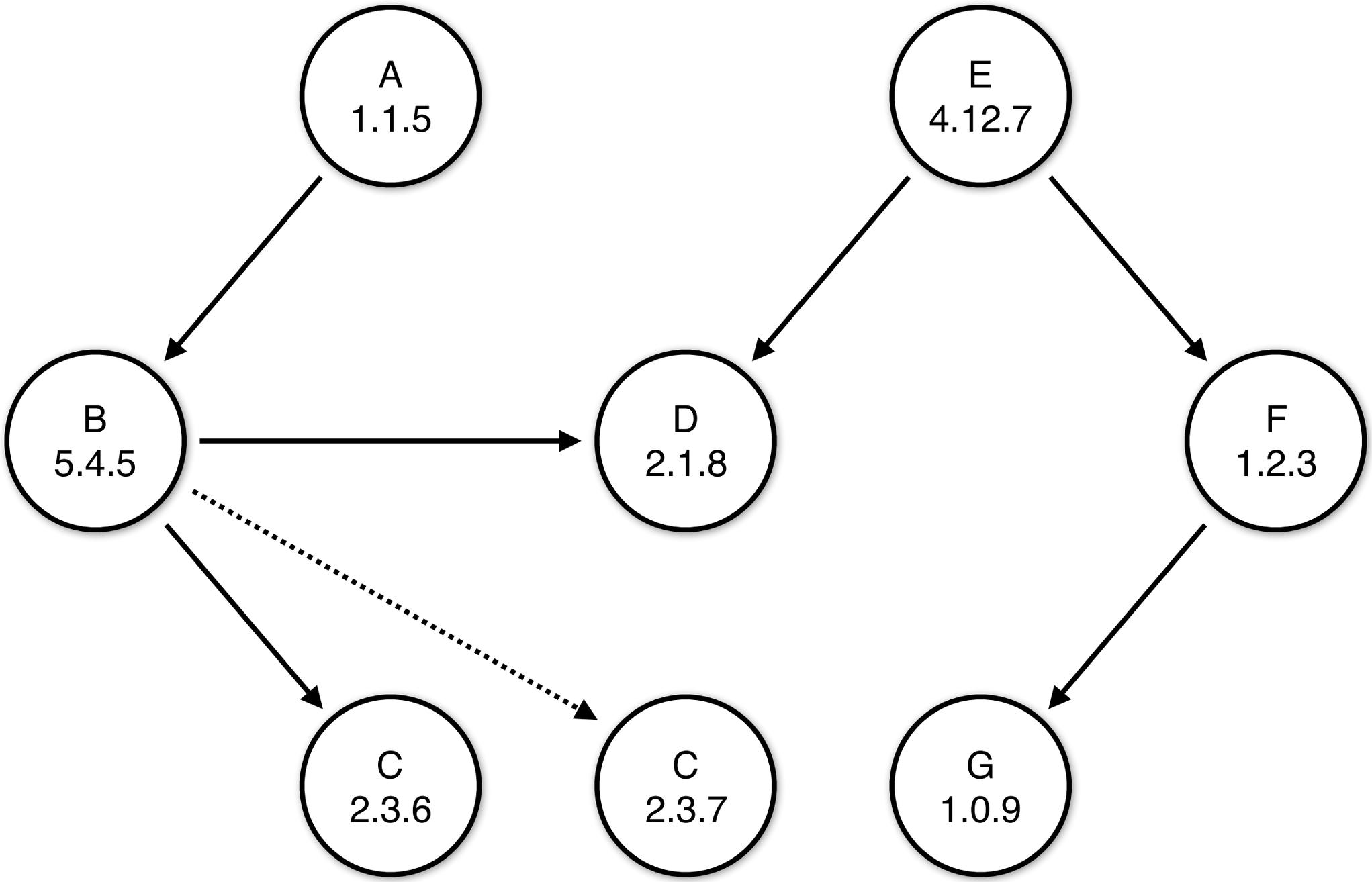

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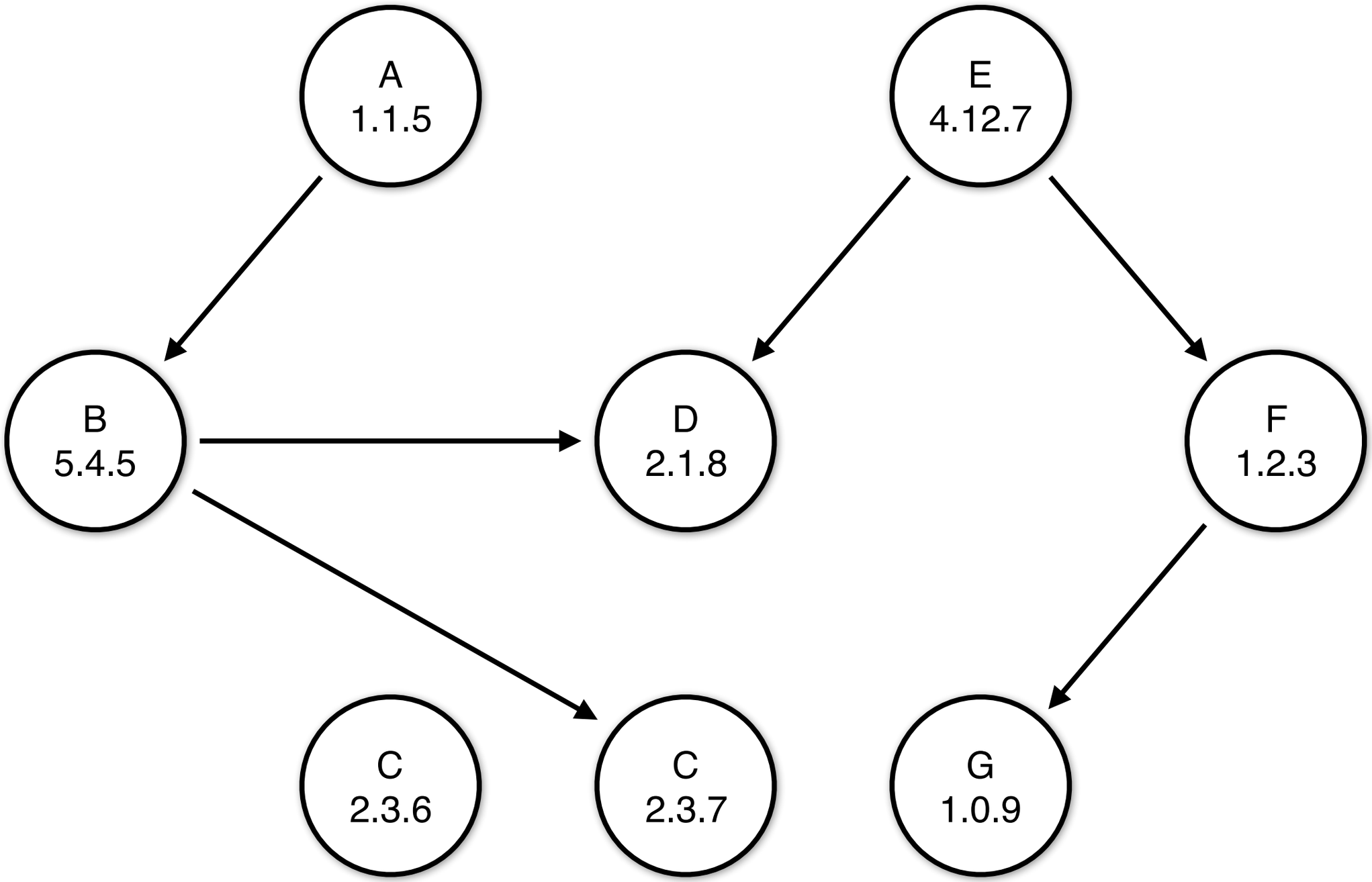

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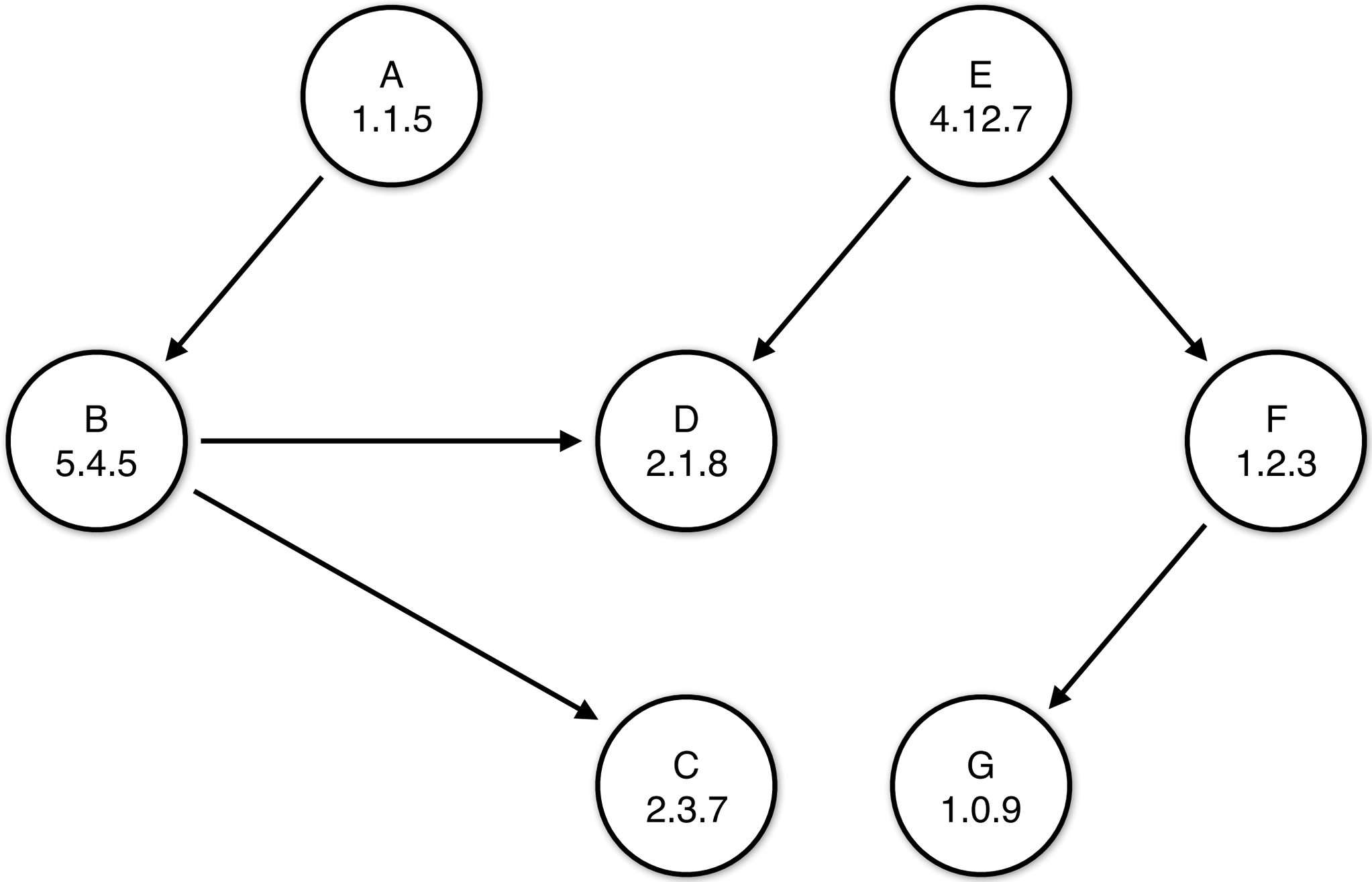
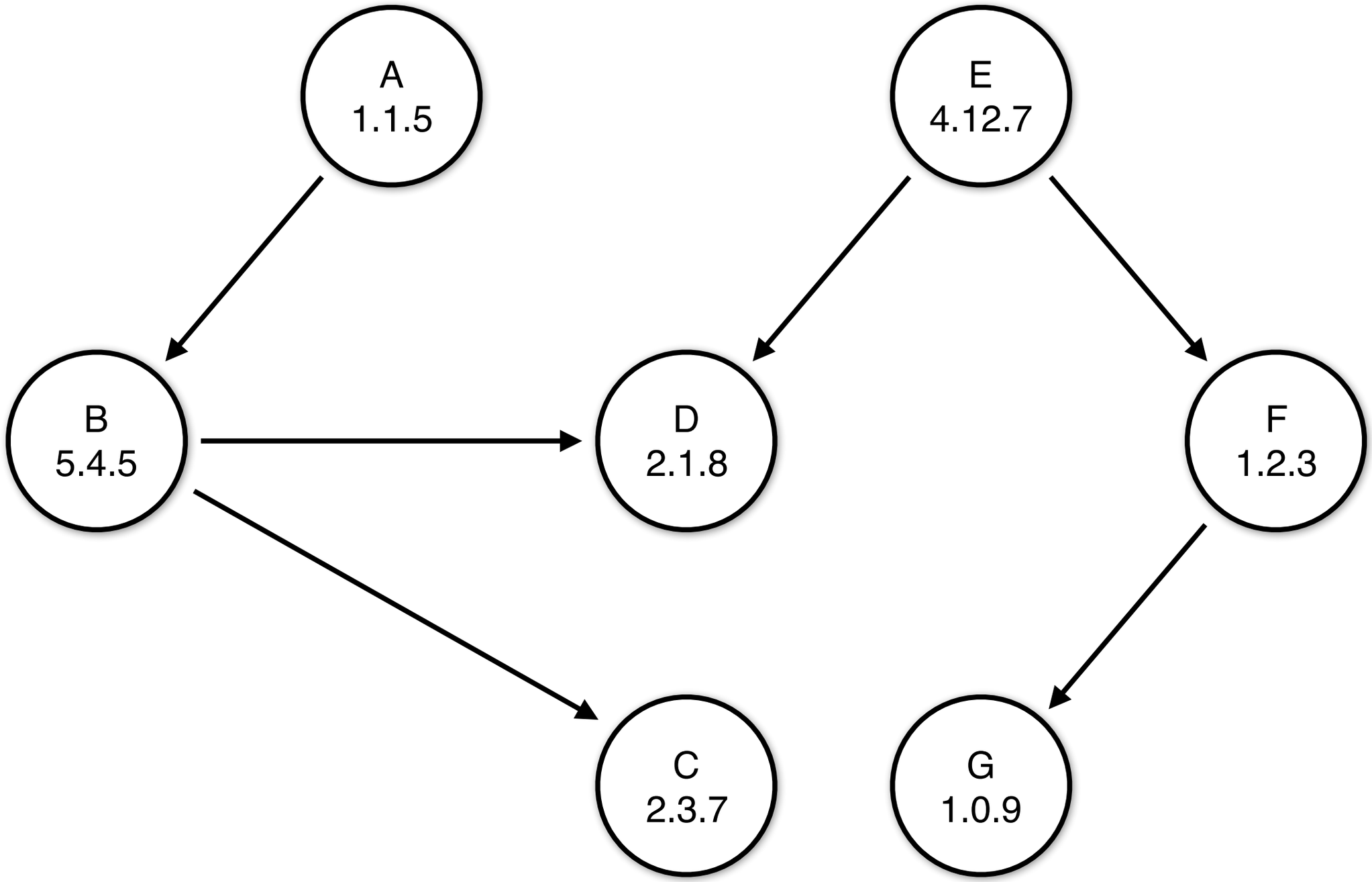


Graph management: pruning



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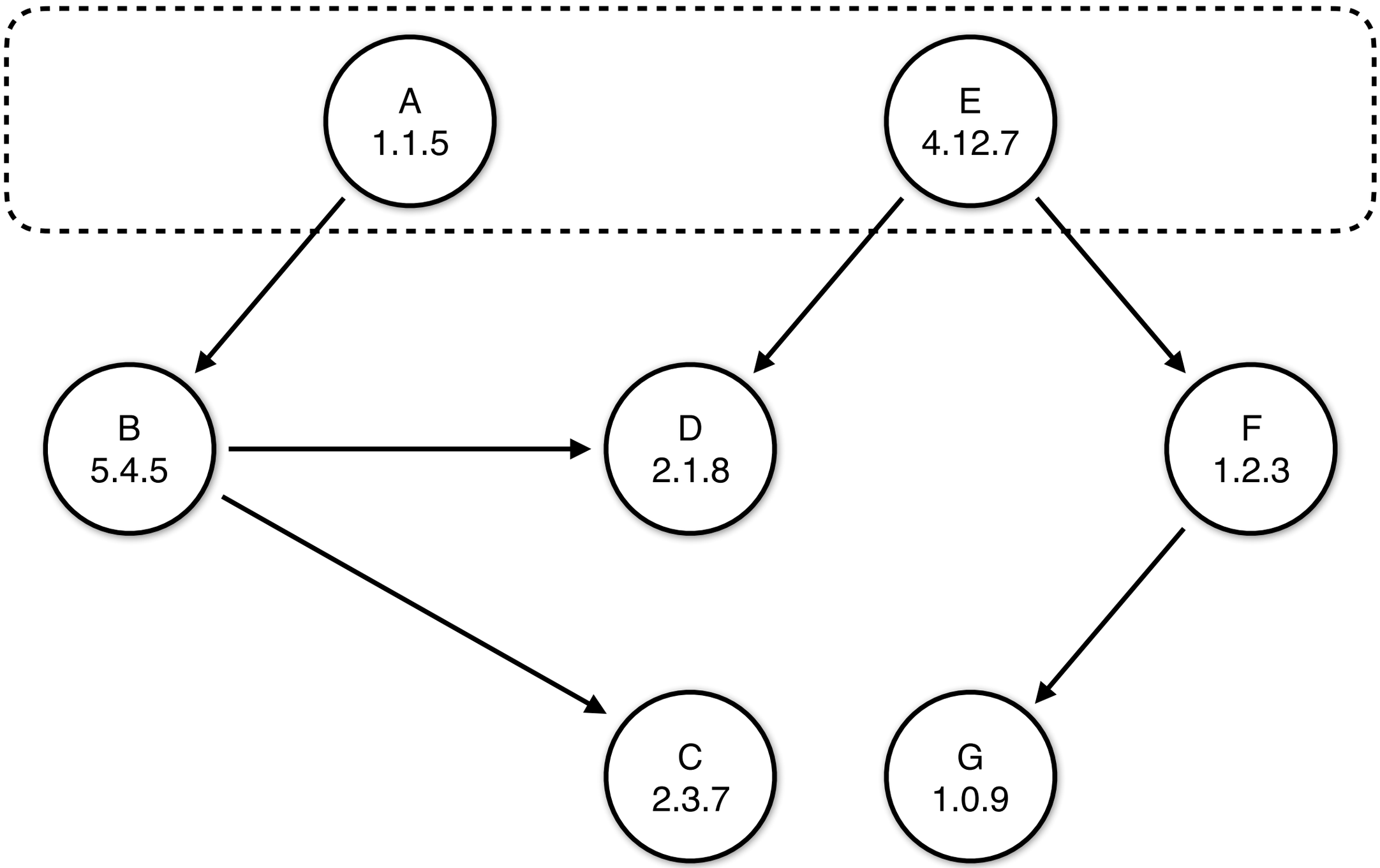

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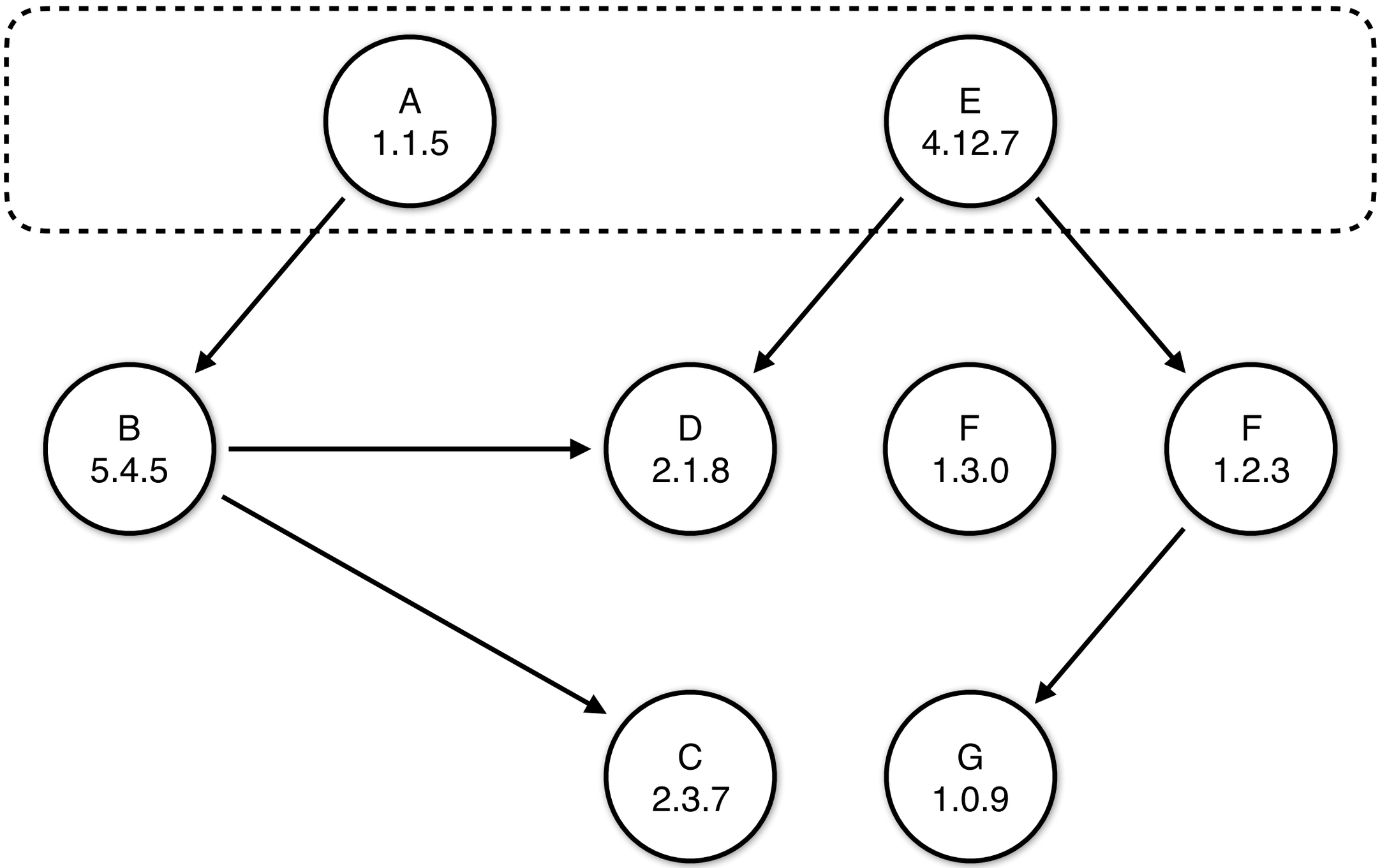

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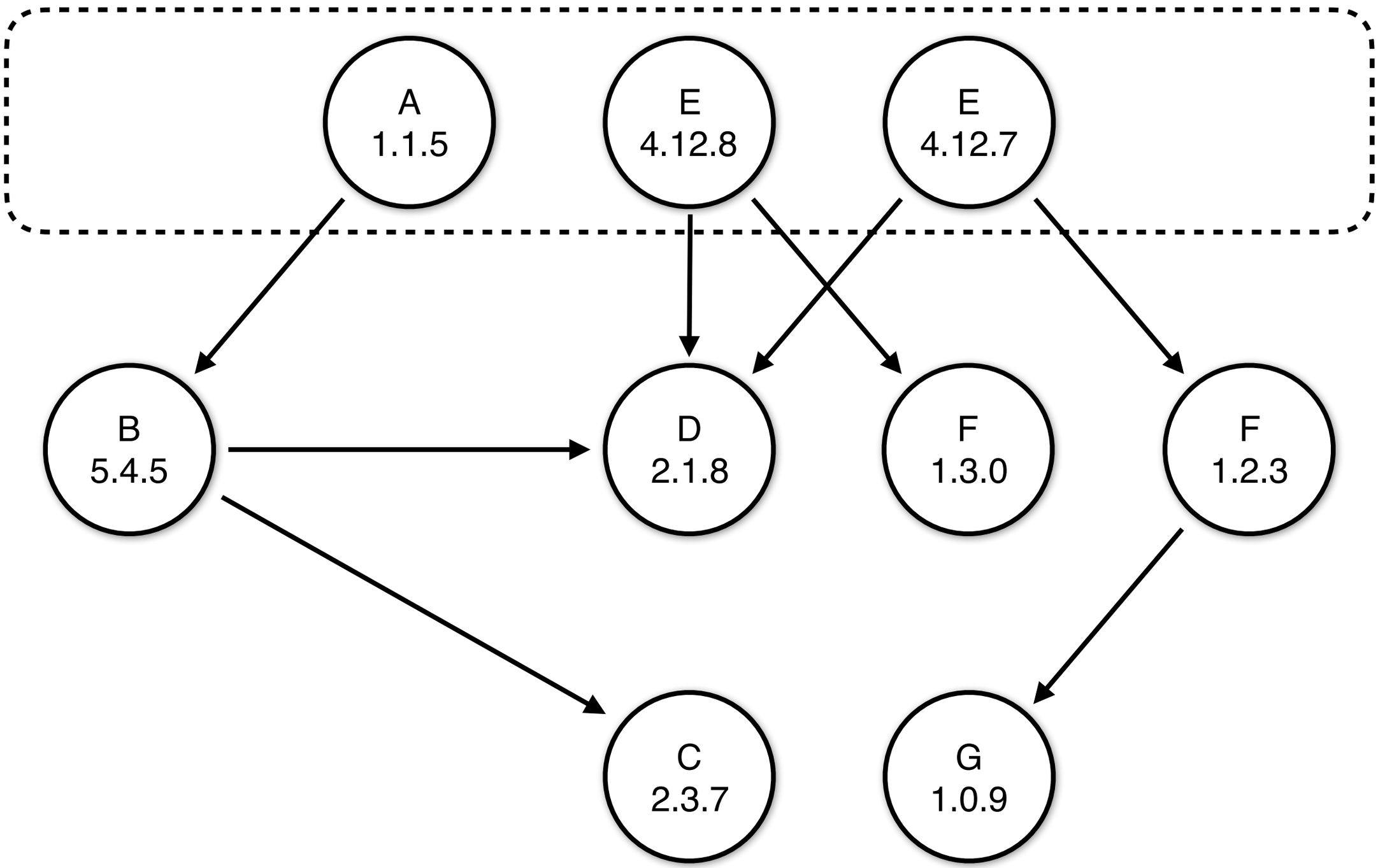

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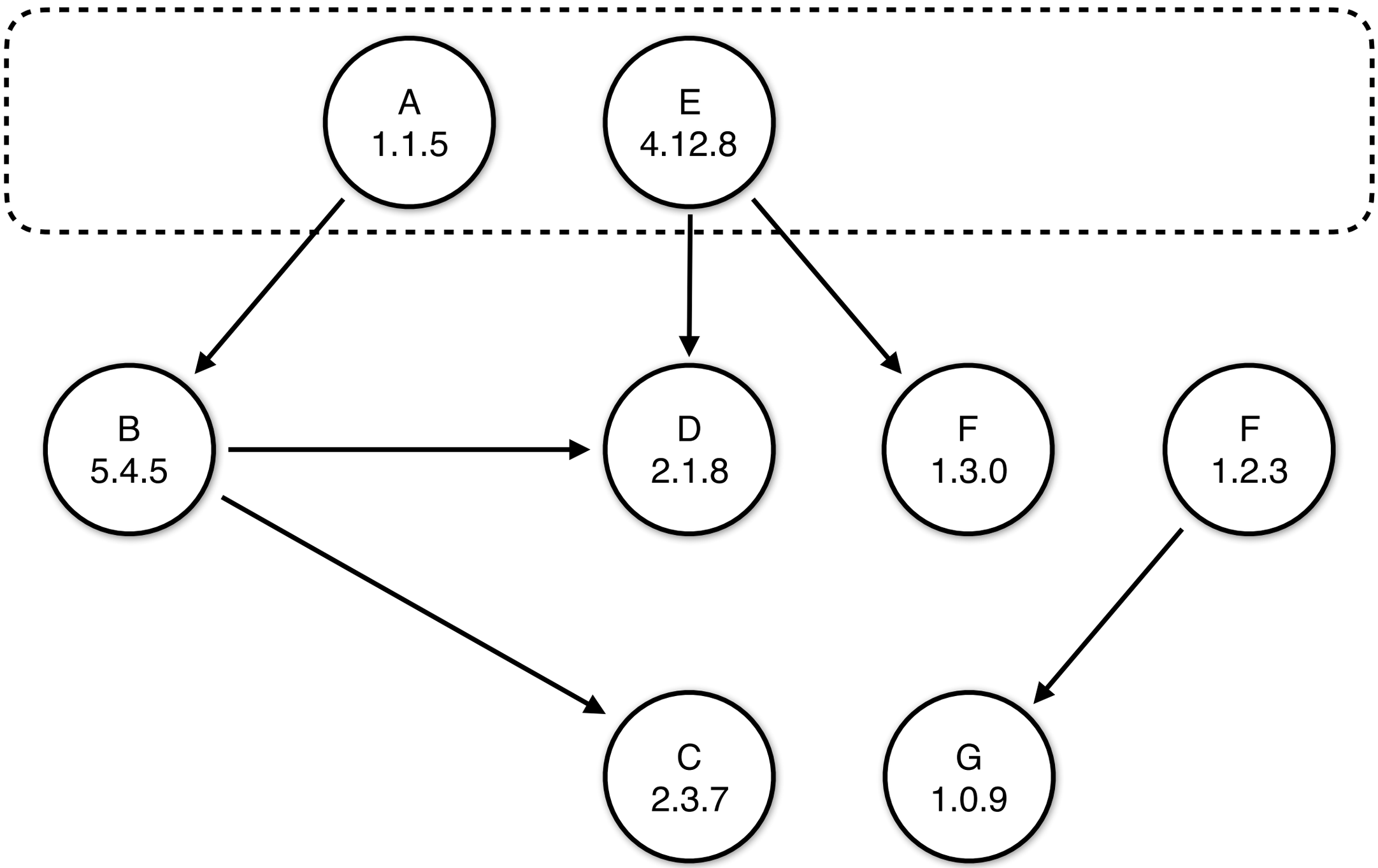

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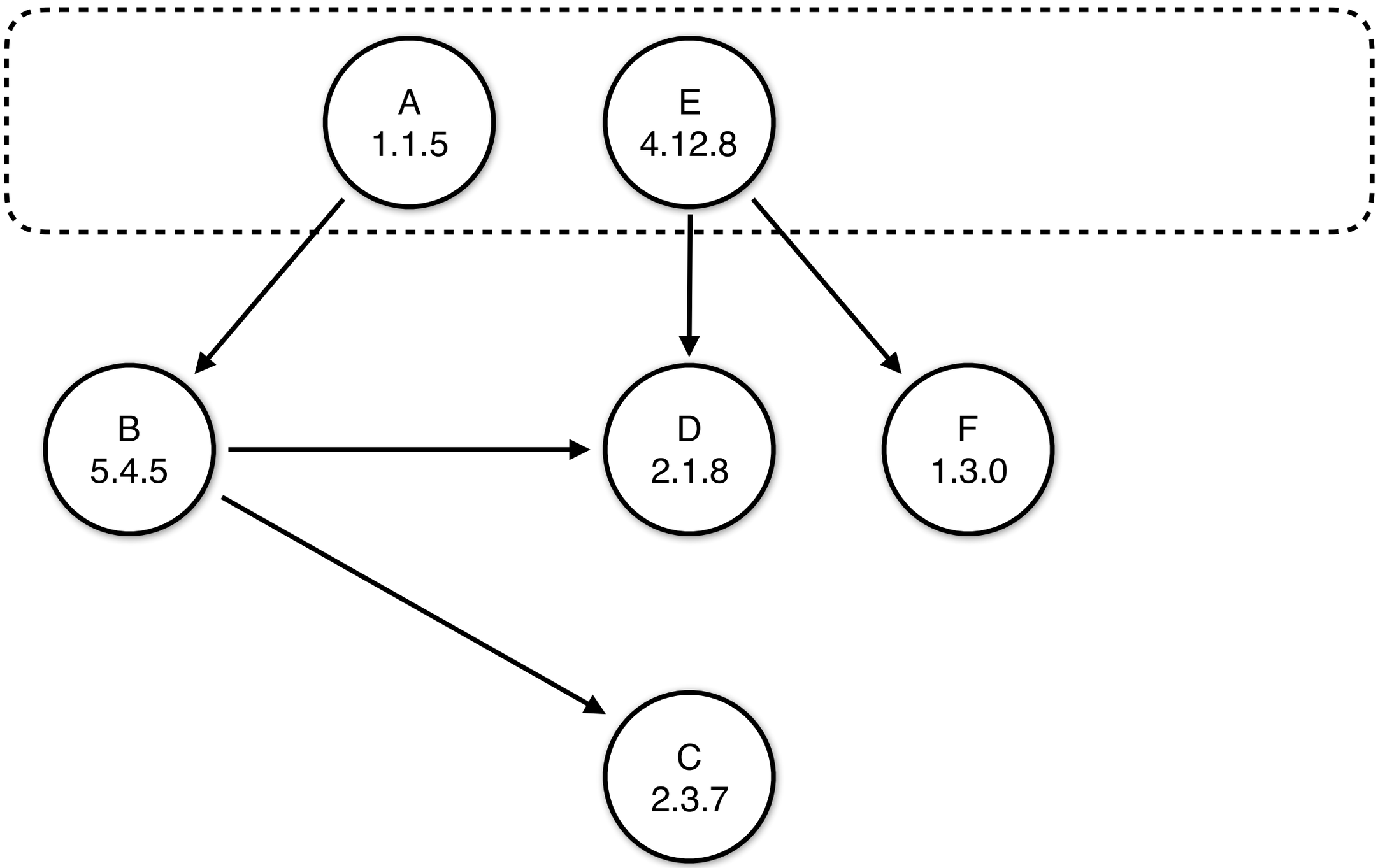

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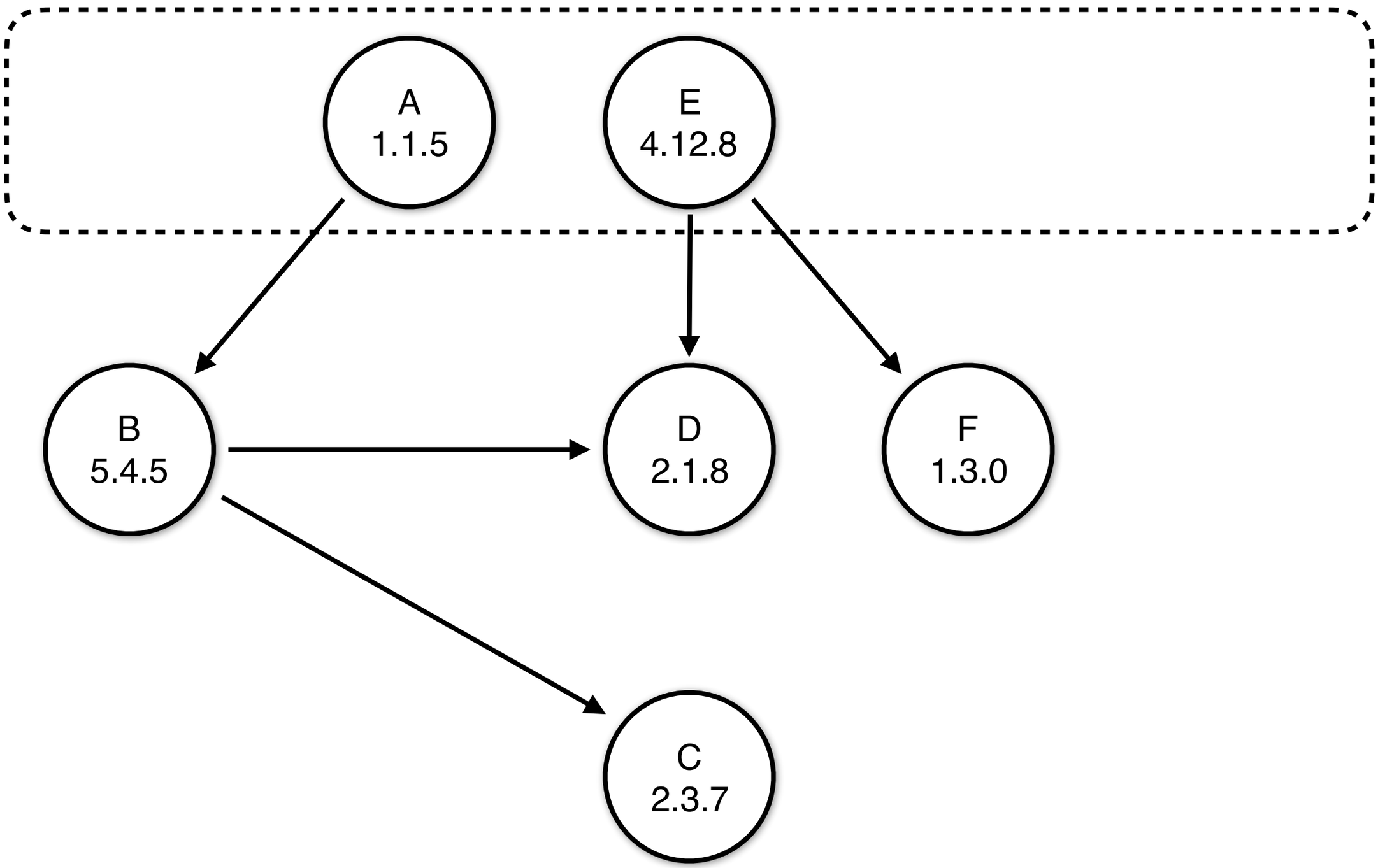

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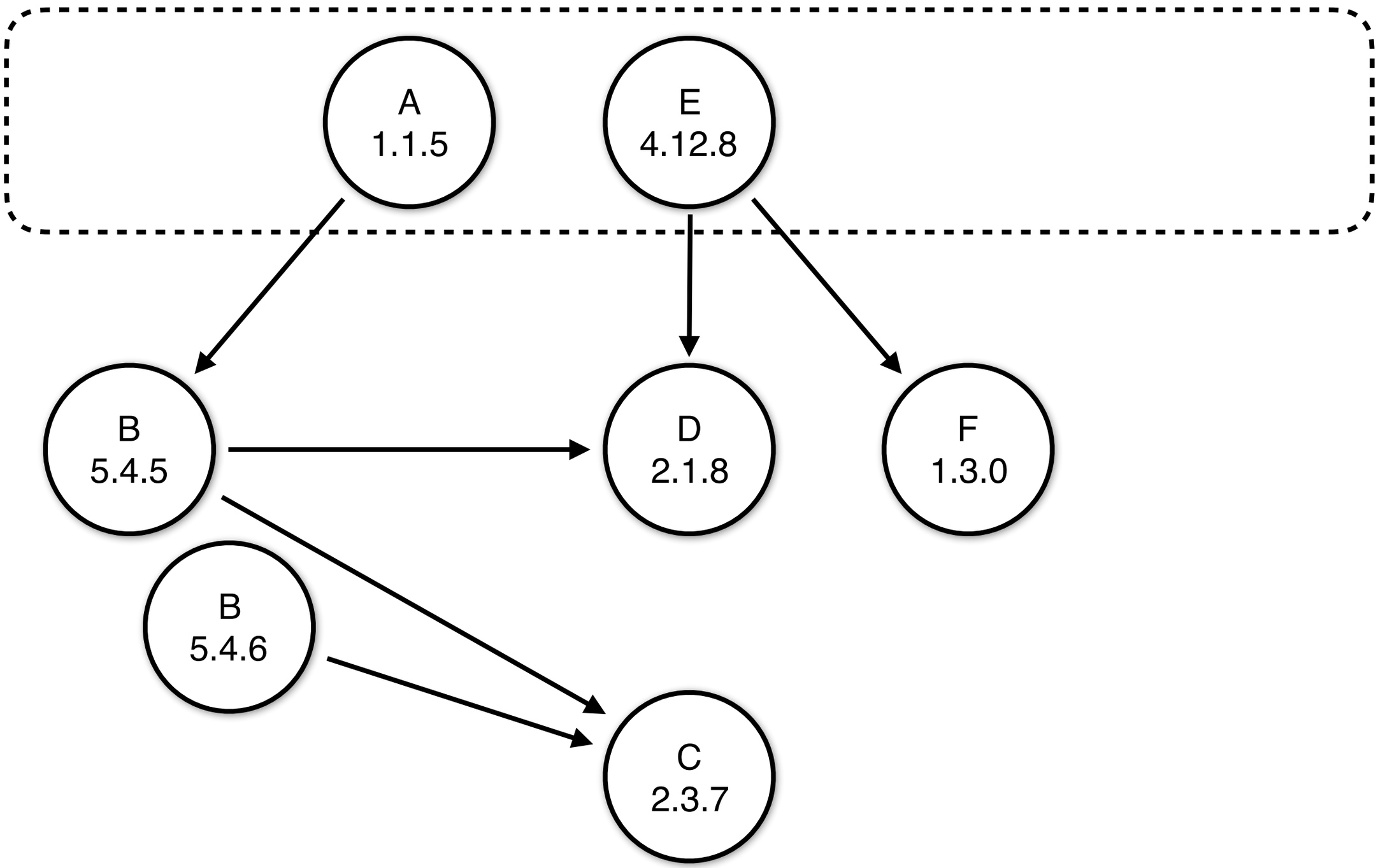

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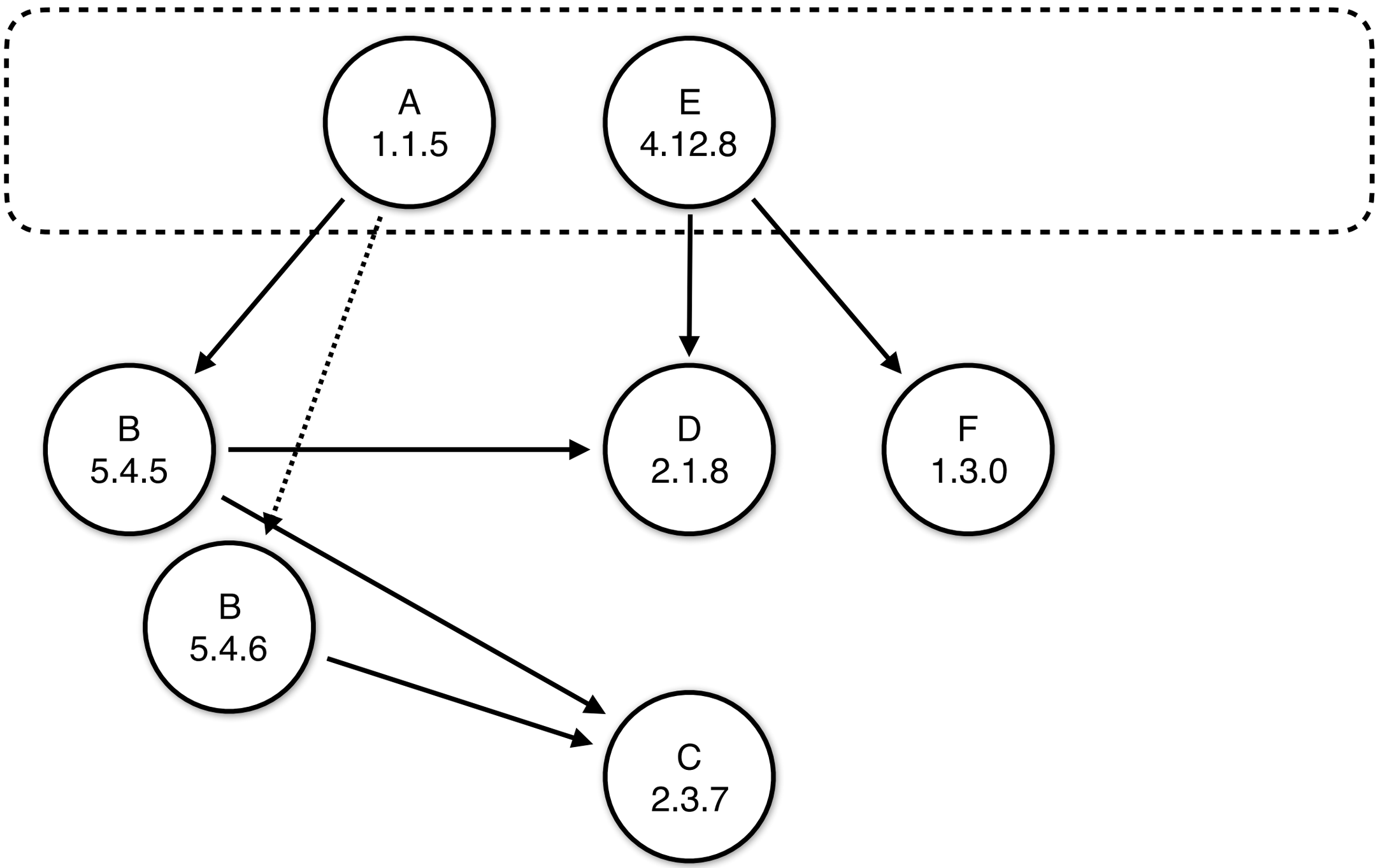

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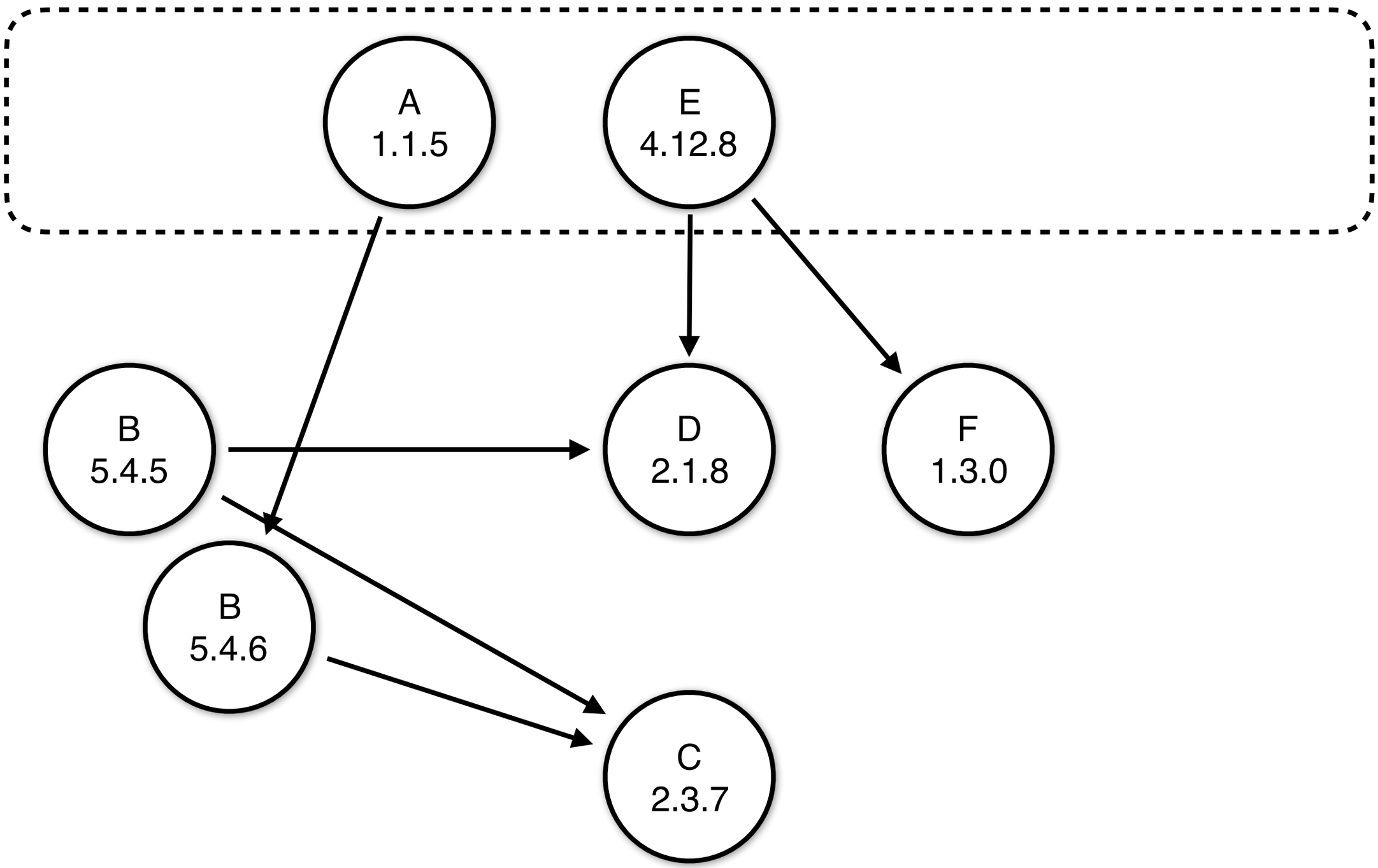

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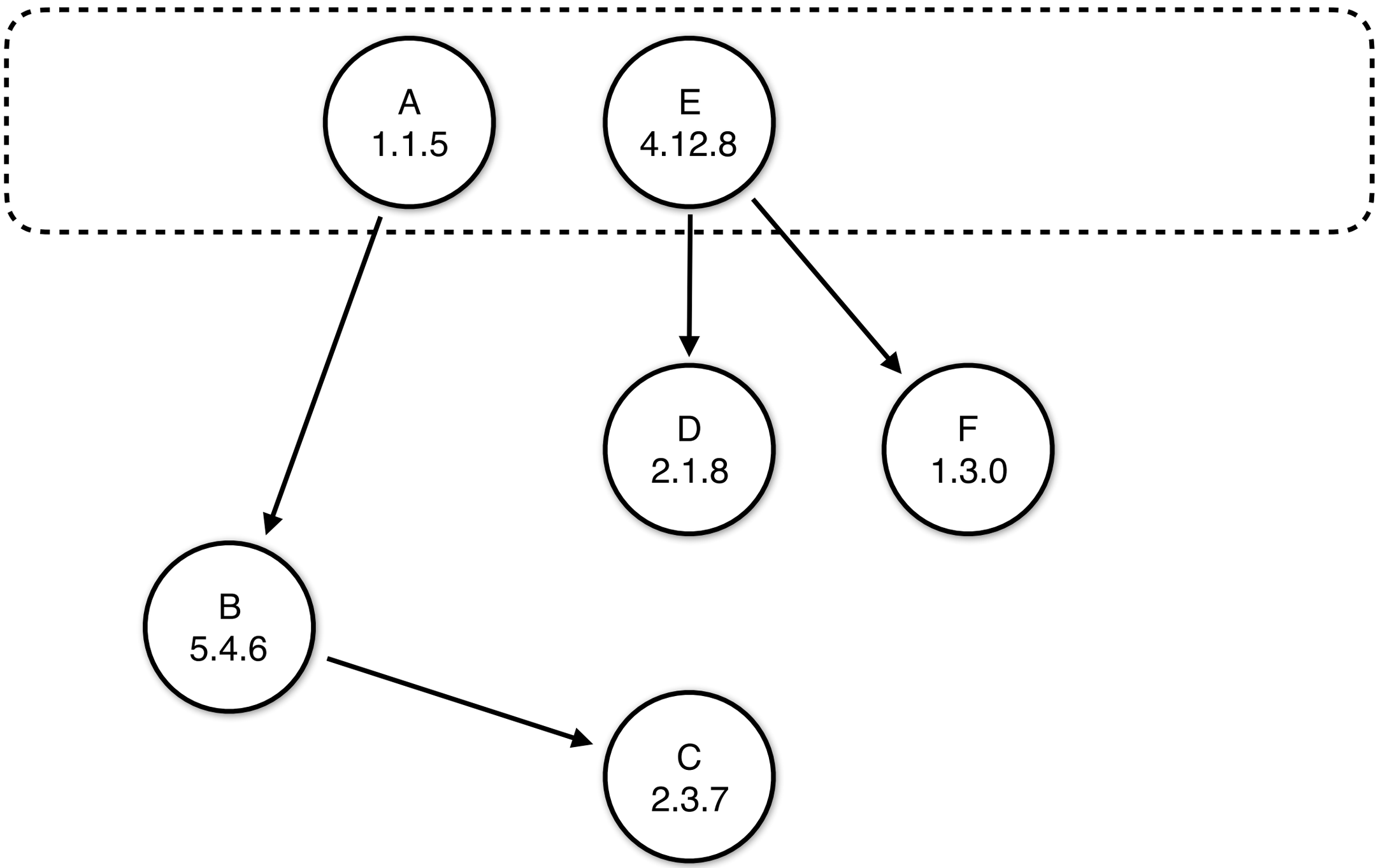

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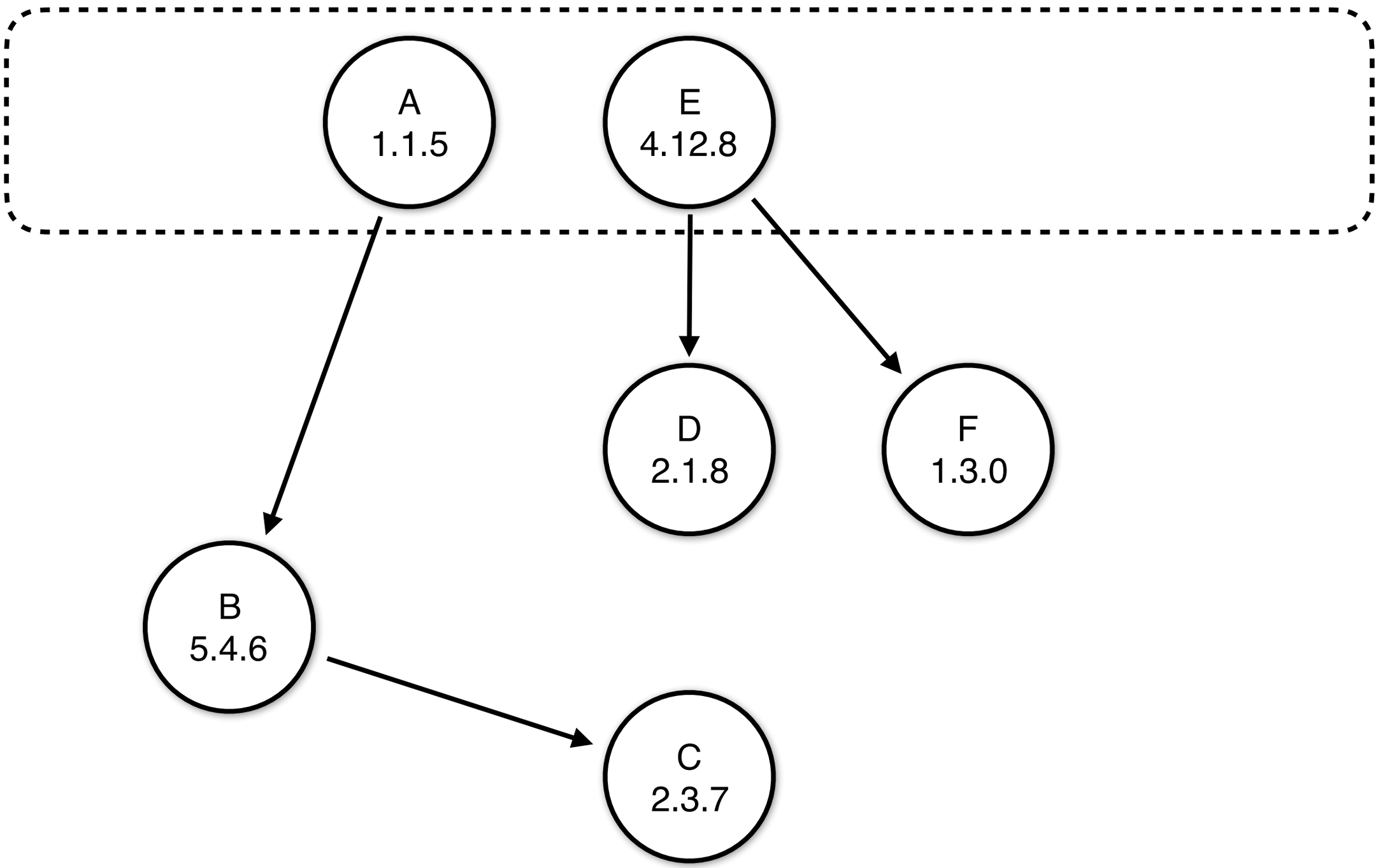

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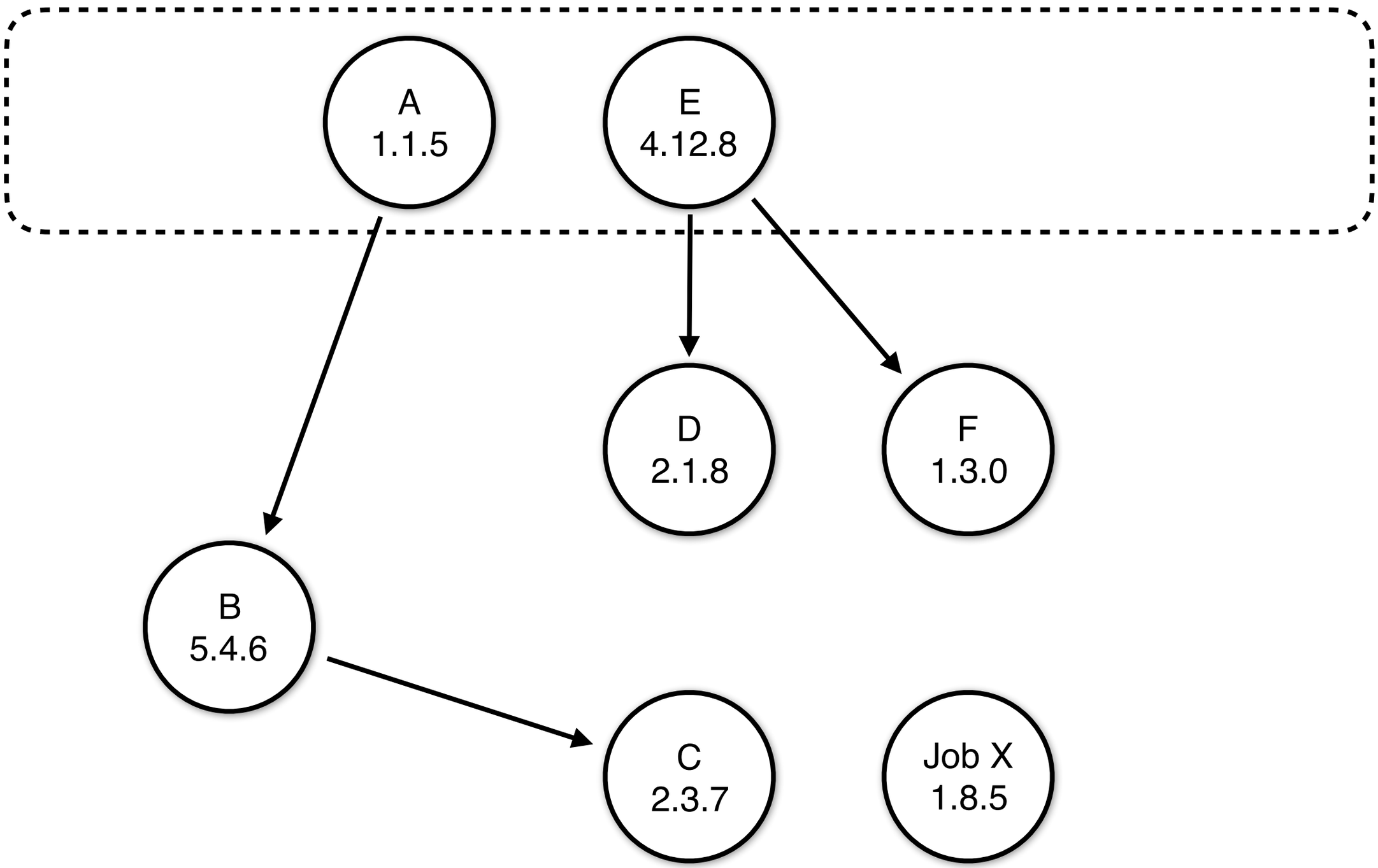
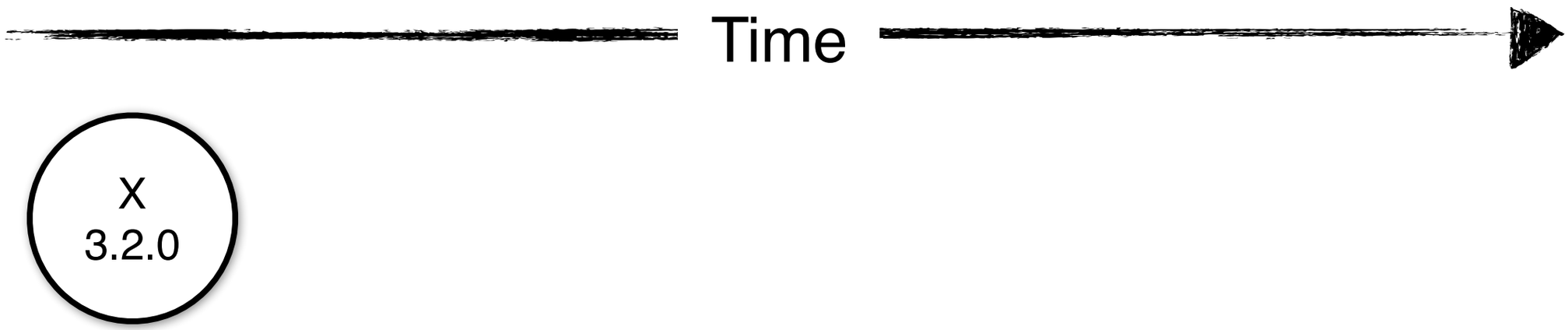



Time

Time

`retain-latest`



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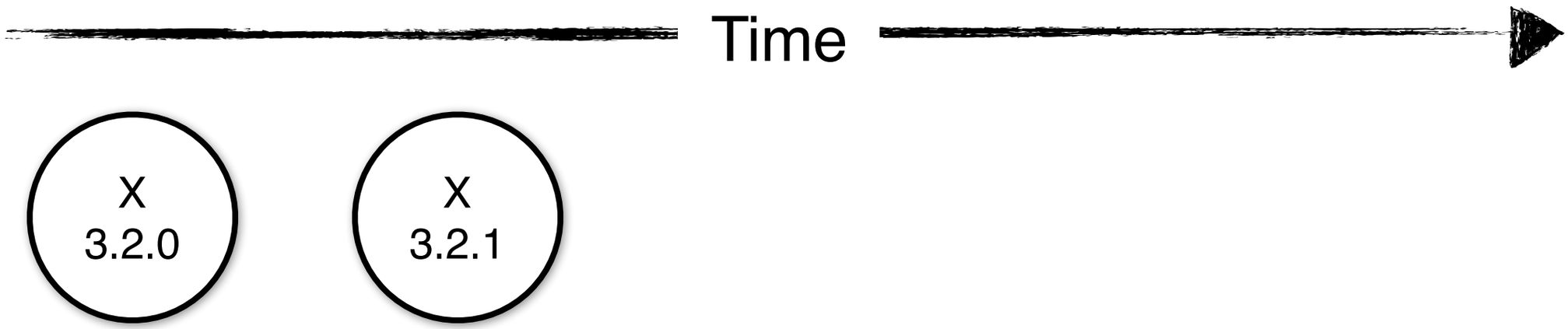
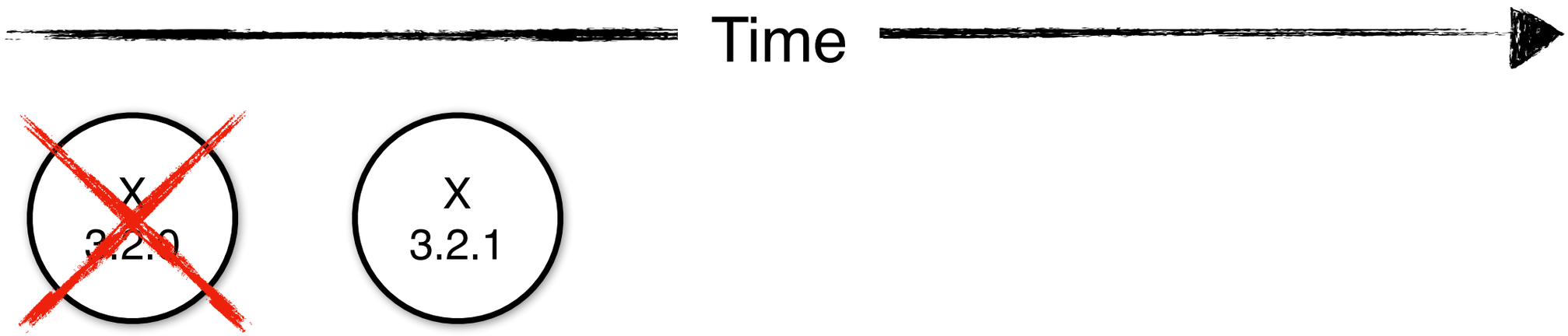
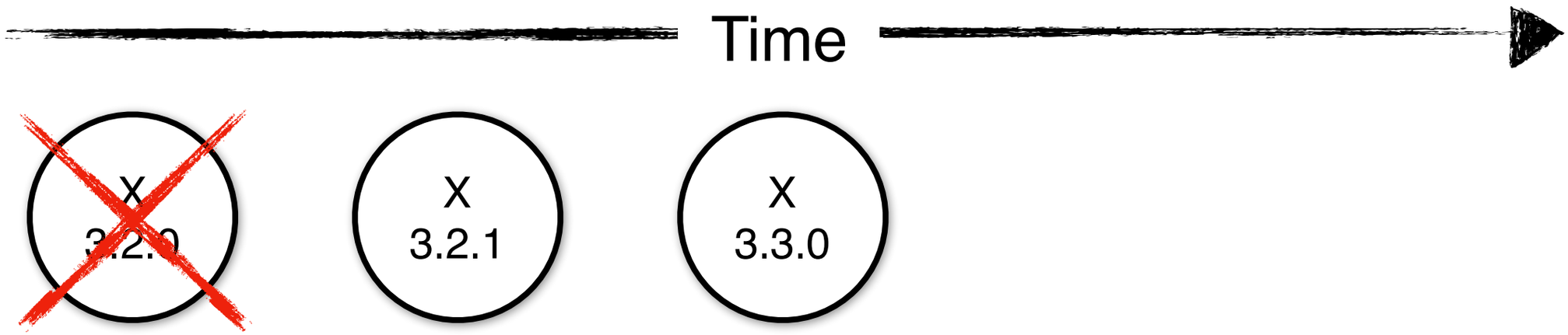
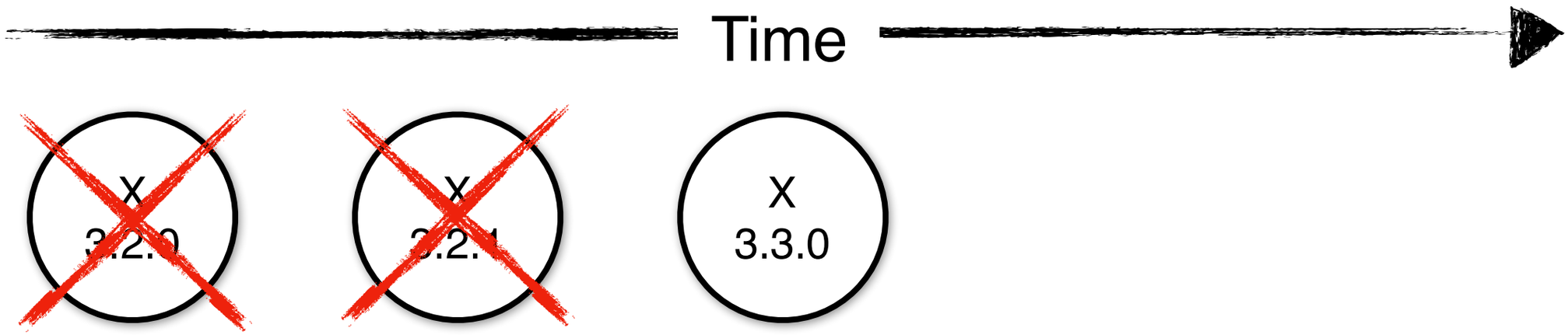


`retain-latest`

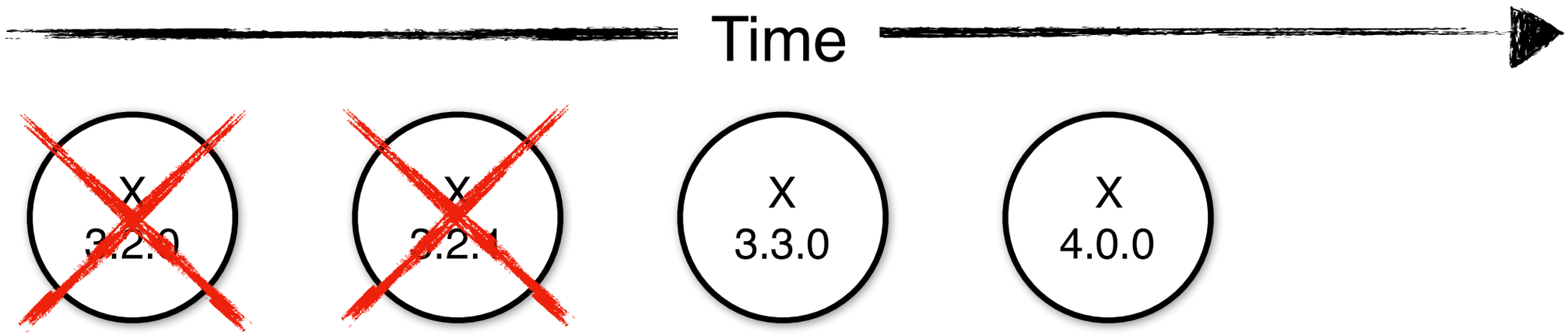


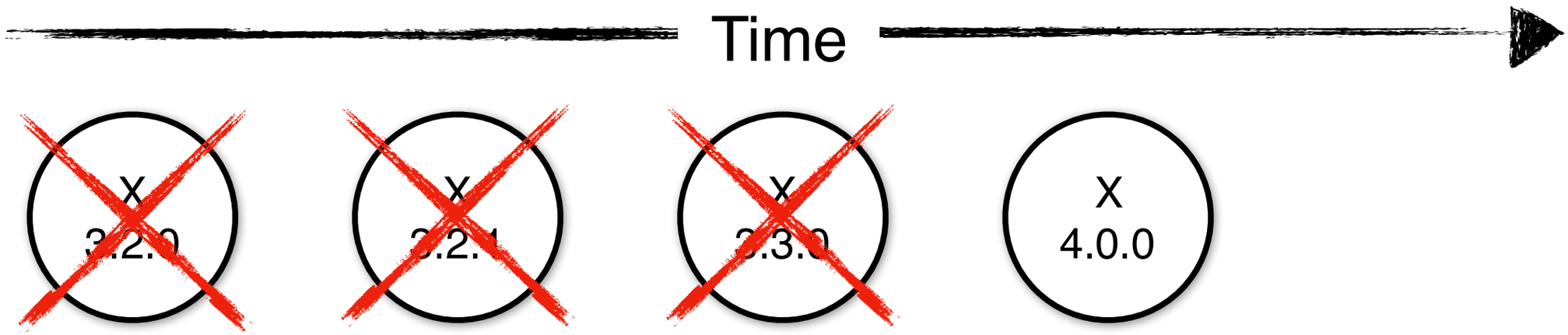
`retain-latest`


Time
X
3.2.0
X
3.2.1
X
3.3.0
retain-latest

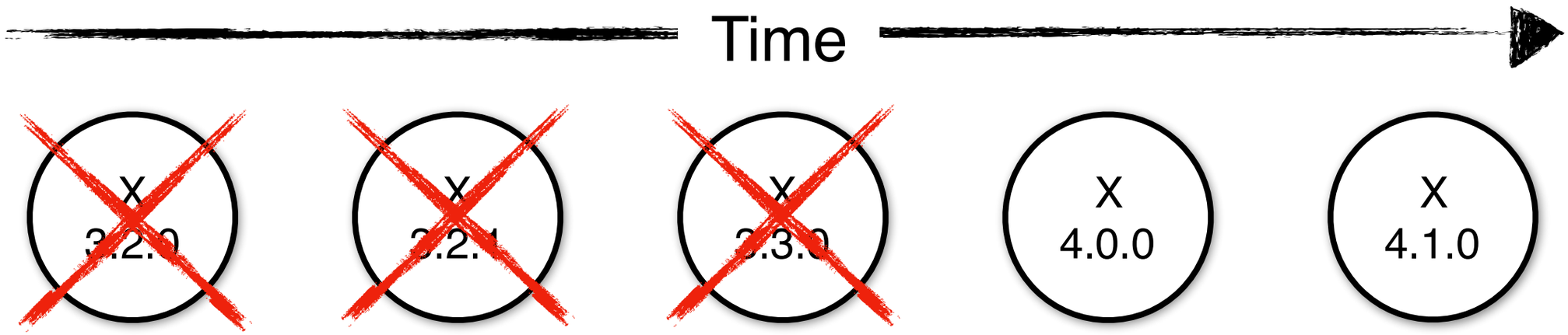


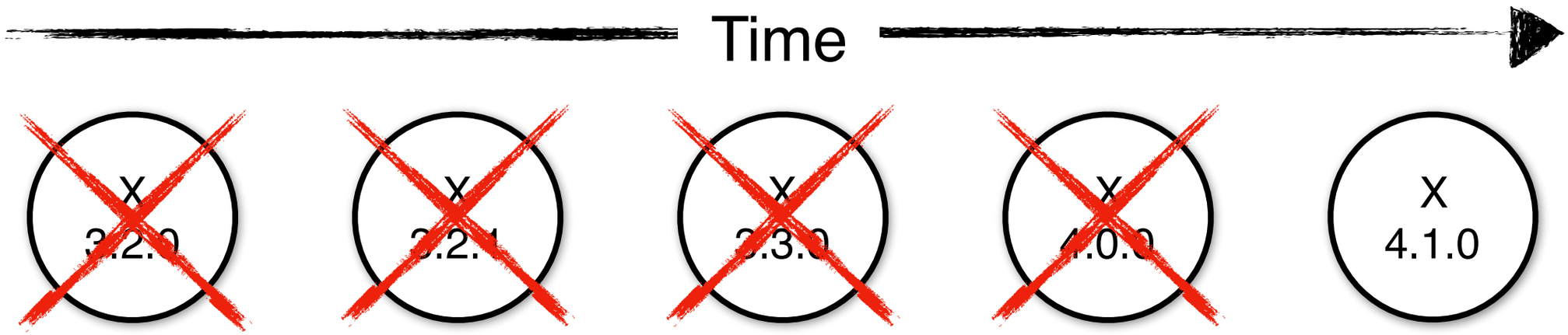
`retain-latest`


Time
X
3.2.0
X
3.2.1
X
3.3.0
X
4.0.0
retain-latest

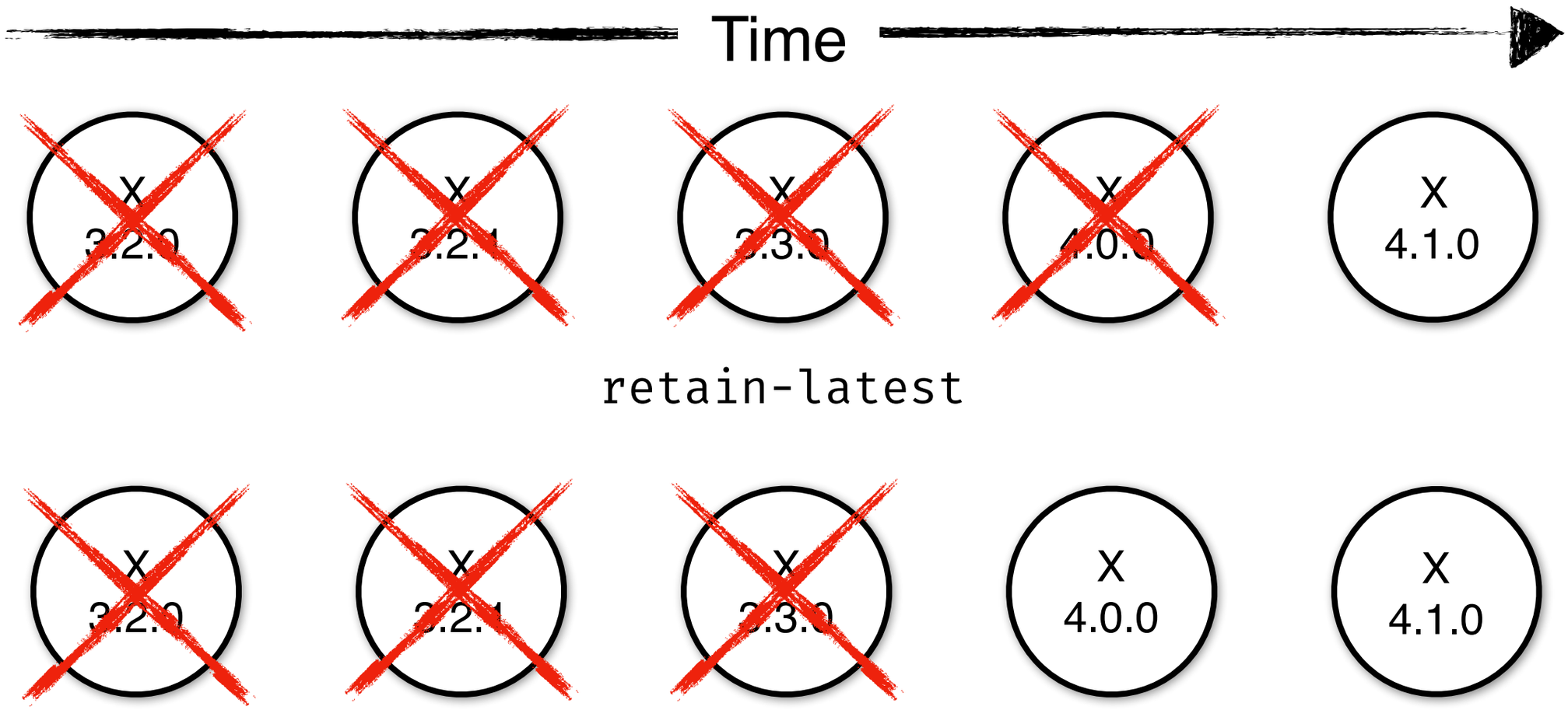


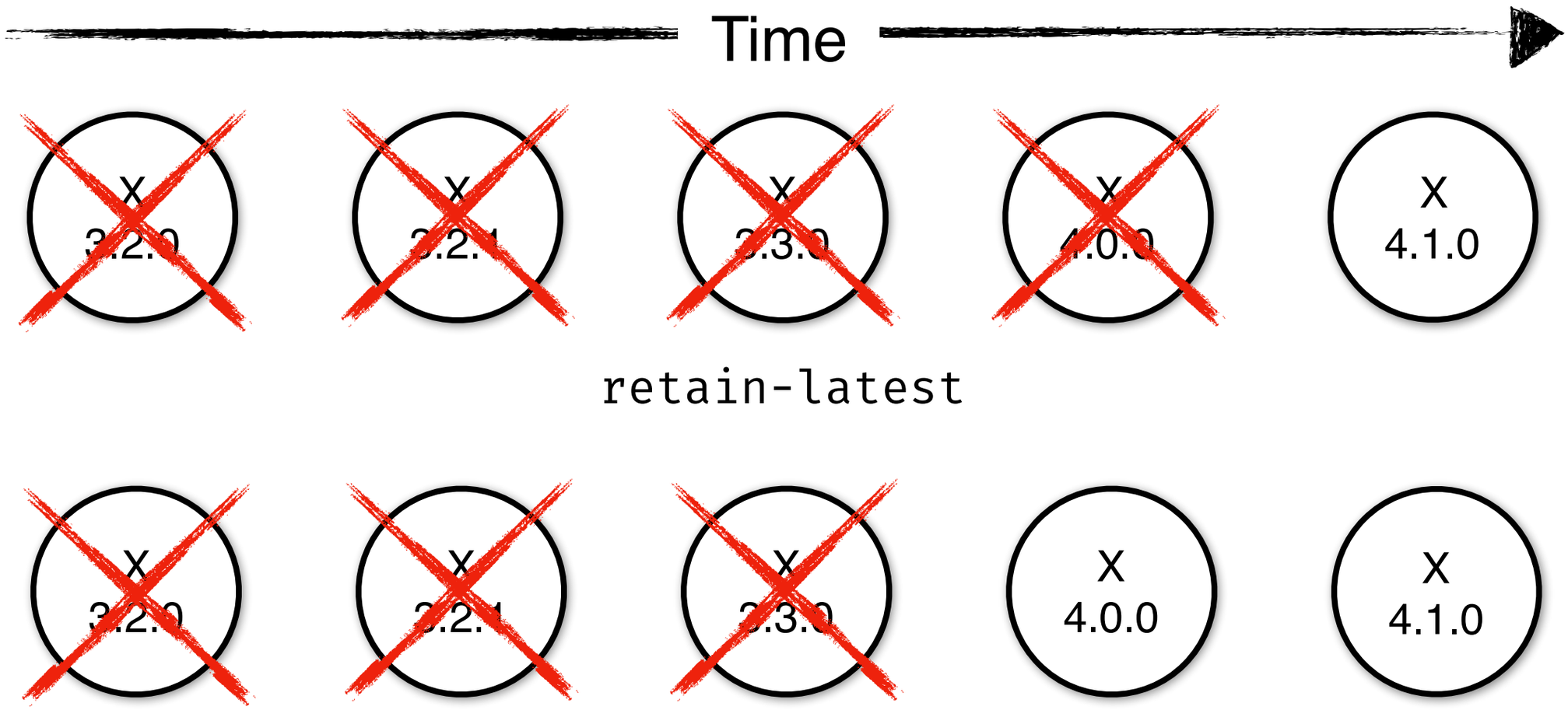
`retain-latest`


Time
X
3.2.0
X
3.2.1
X
3.3.0
X
4.0.0
X
4.1.0
retain-latest

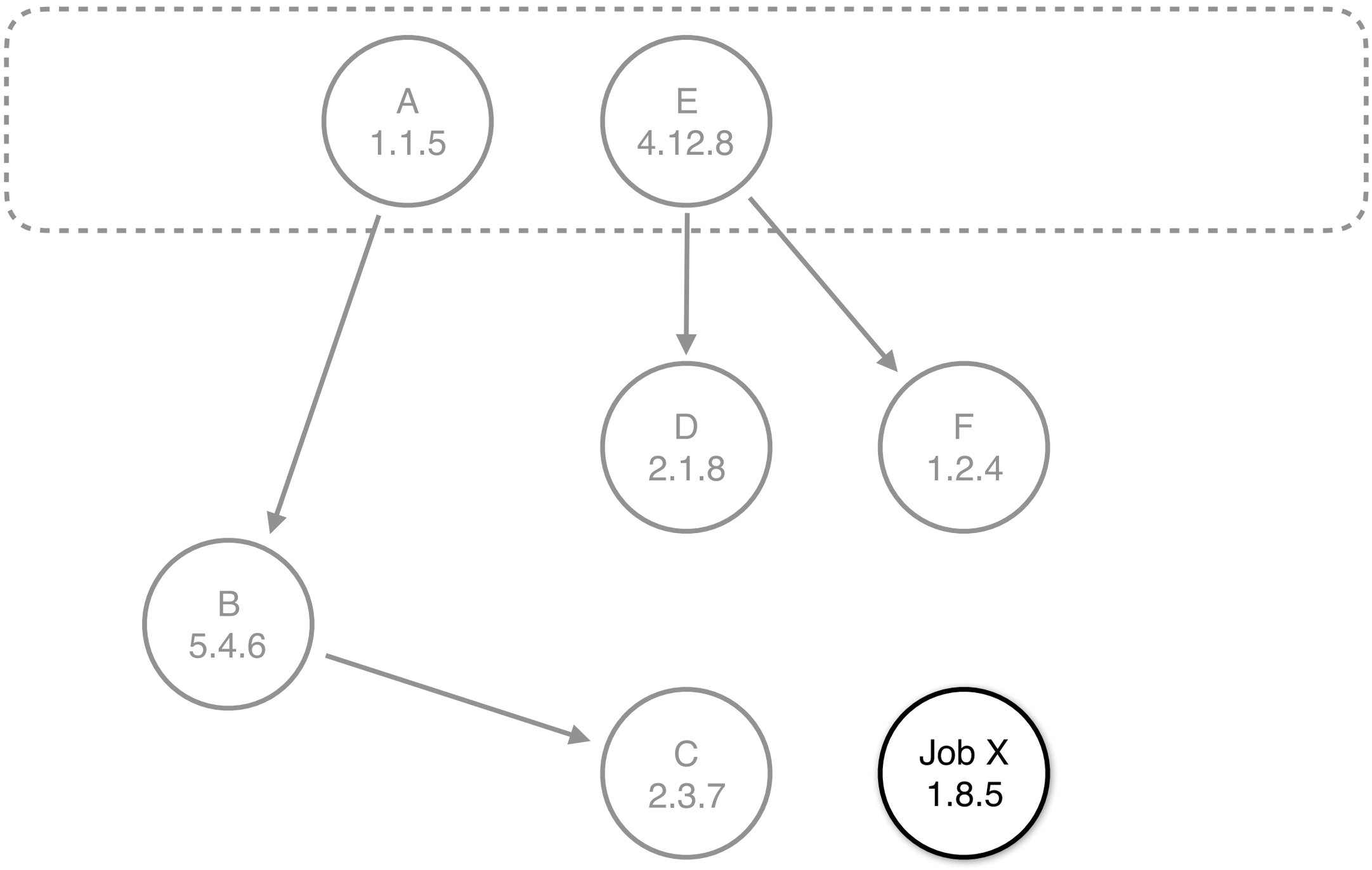


`retain-latest`

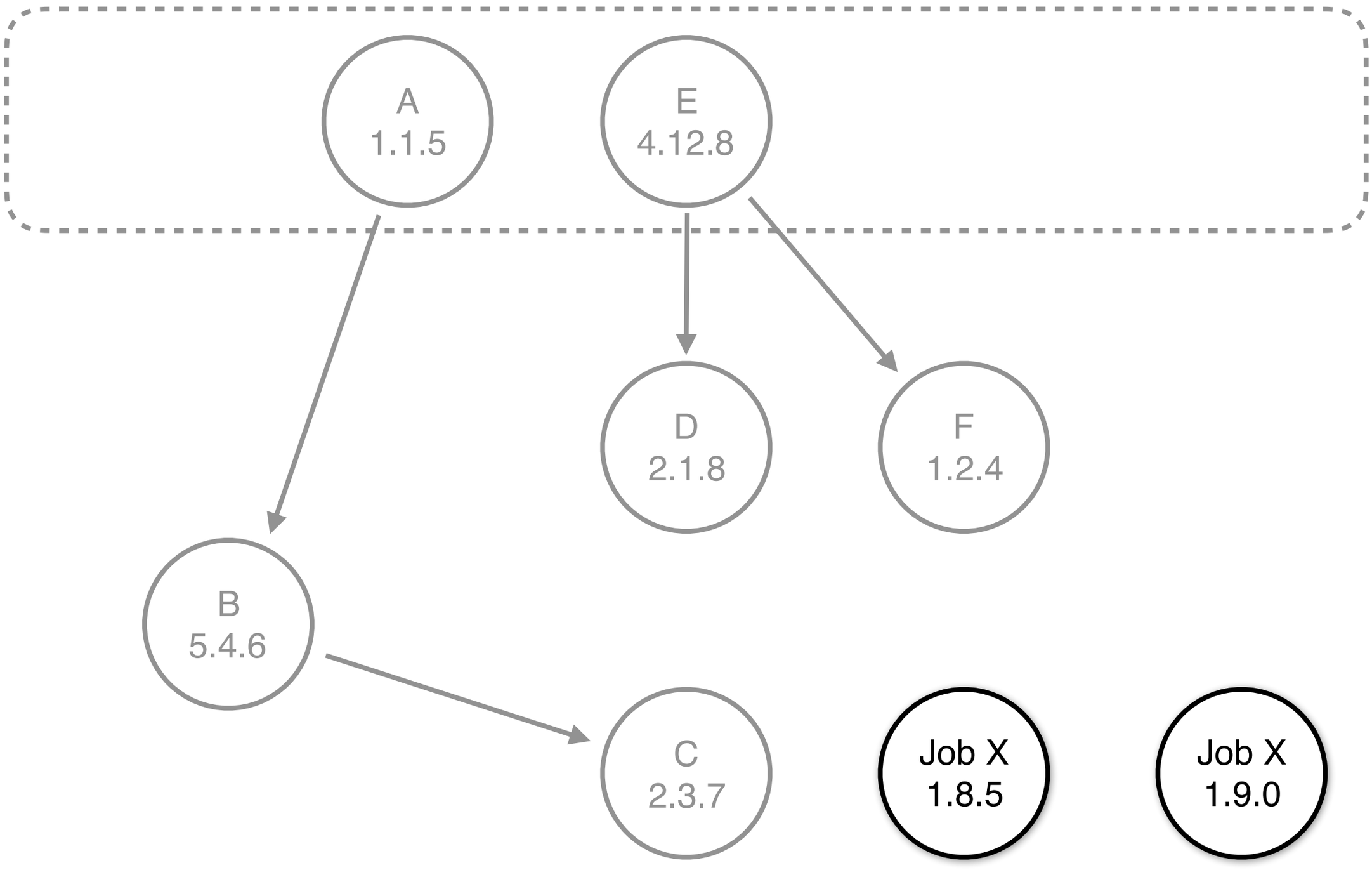

Time
X
3.2.0
X
3.2.1
X
3.3.0
X
4.0.0
X
4.1.0
retain-latest
X
3.2.0
X
3.2.1
X
3.3.0
X
4.0.0
X
4.1.0
retain-latest-two-major


Time
X
3.2.0
X
3.2.1
X
3.3.0
X
4.0.0
X
4.1.0
retain-latest
X
3.2.0
X
3.2.1
X
3.3.0
X
4.0.0
X
4.1.0
retain-latest-two-major
X
3.2.0
X
3.2.1
X
3.3.0
X
4.0.0
X
4.1.0
retain-latest-two-feature

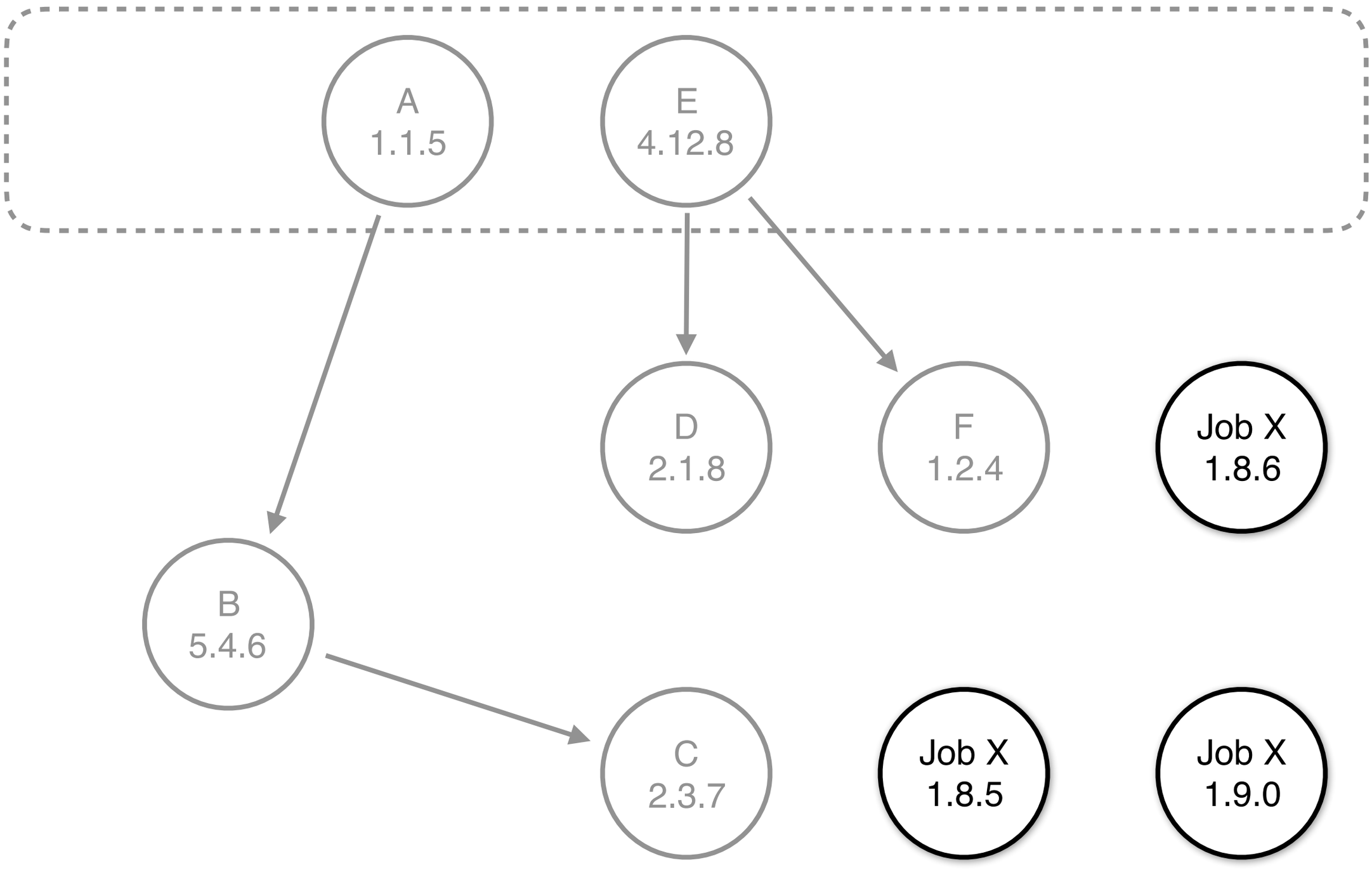
Graph management: pruning



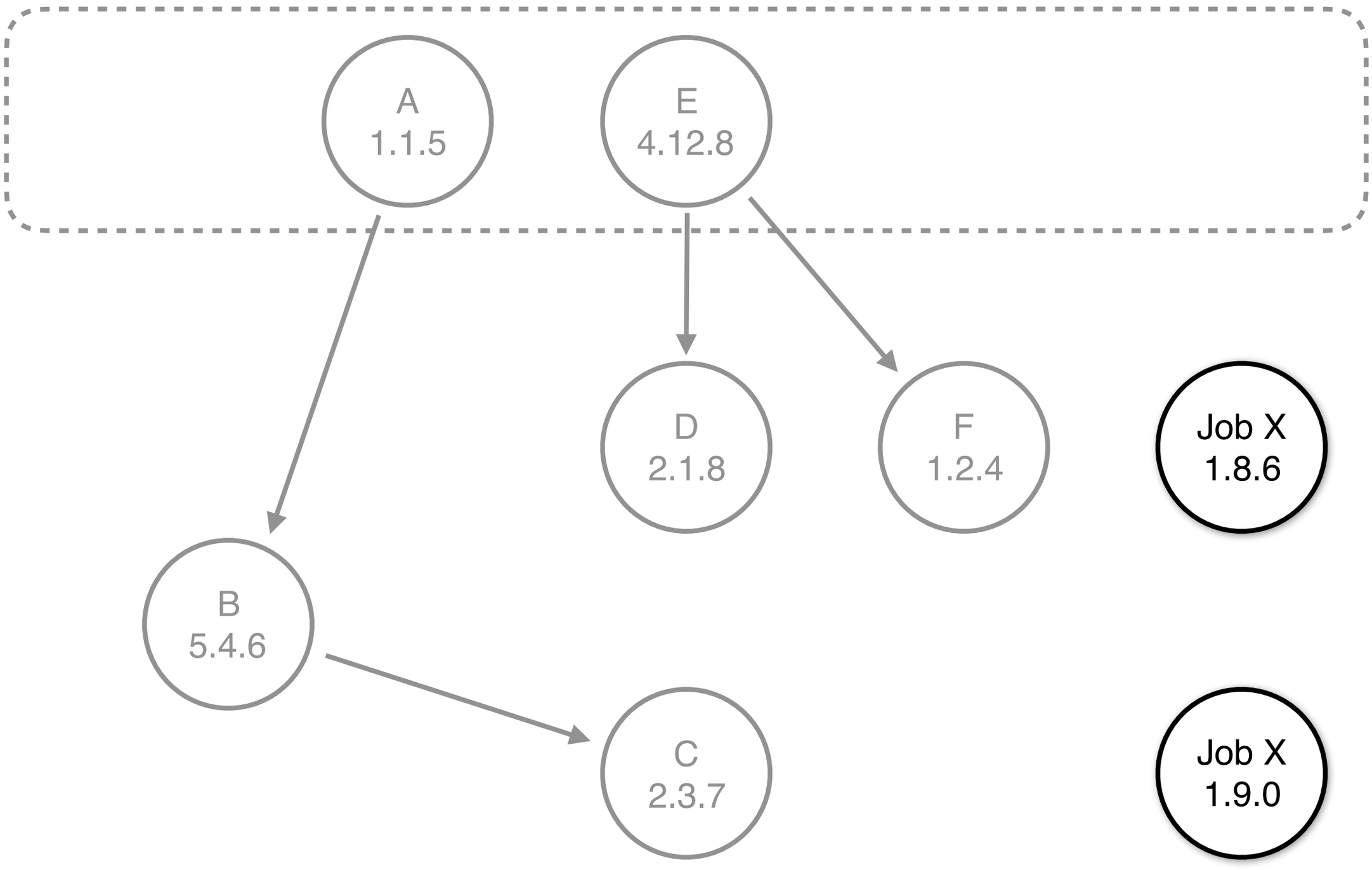
Graph management: pruning



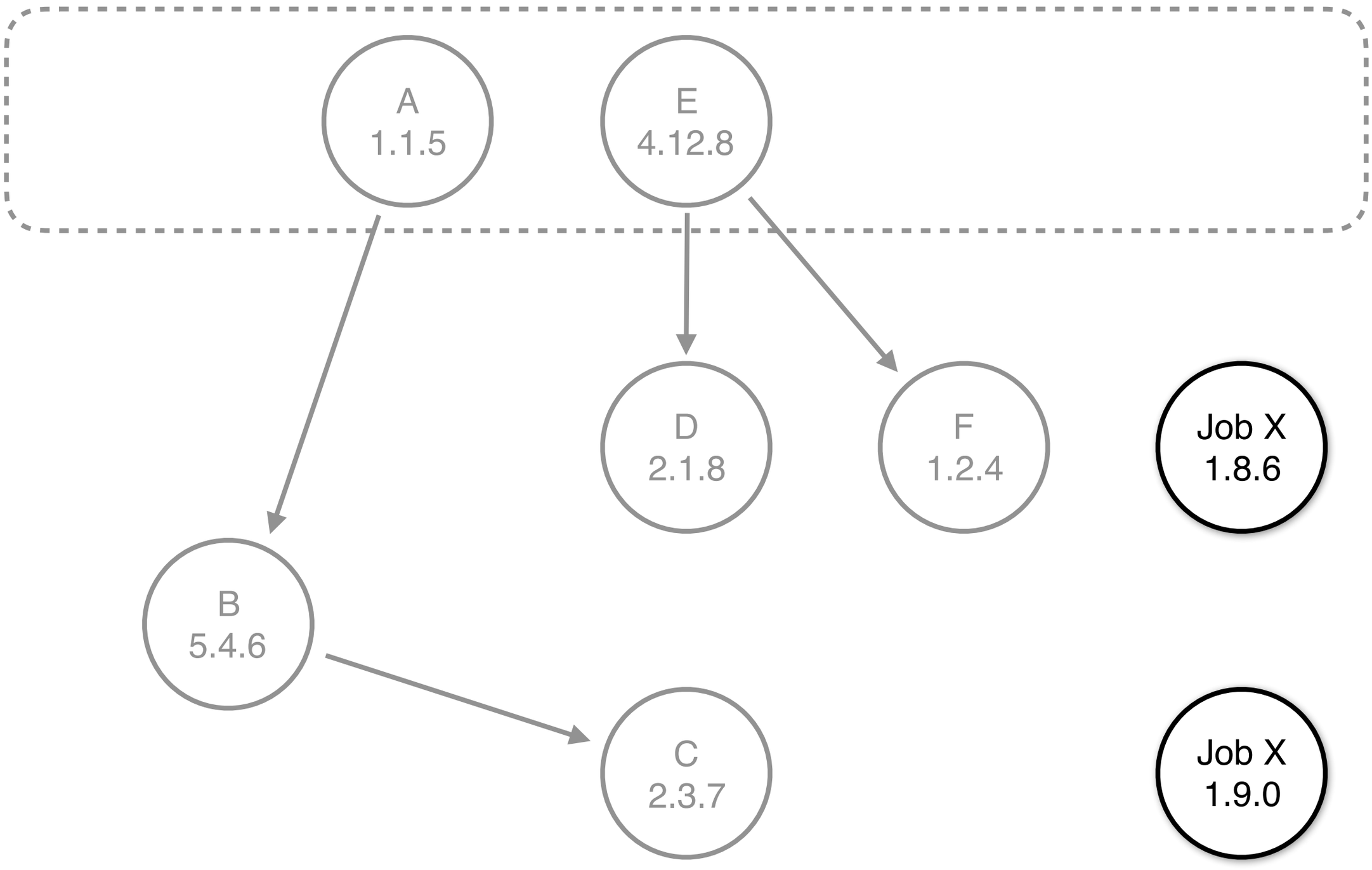
Graph management: pruning



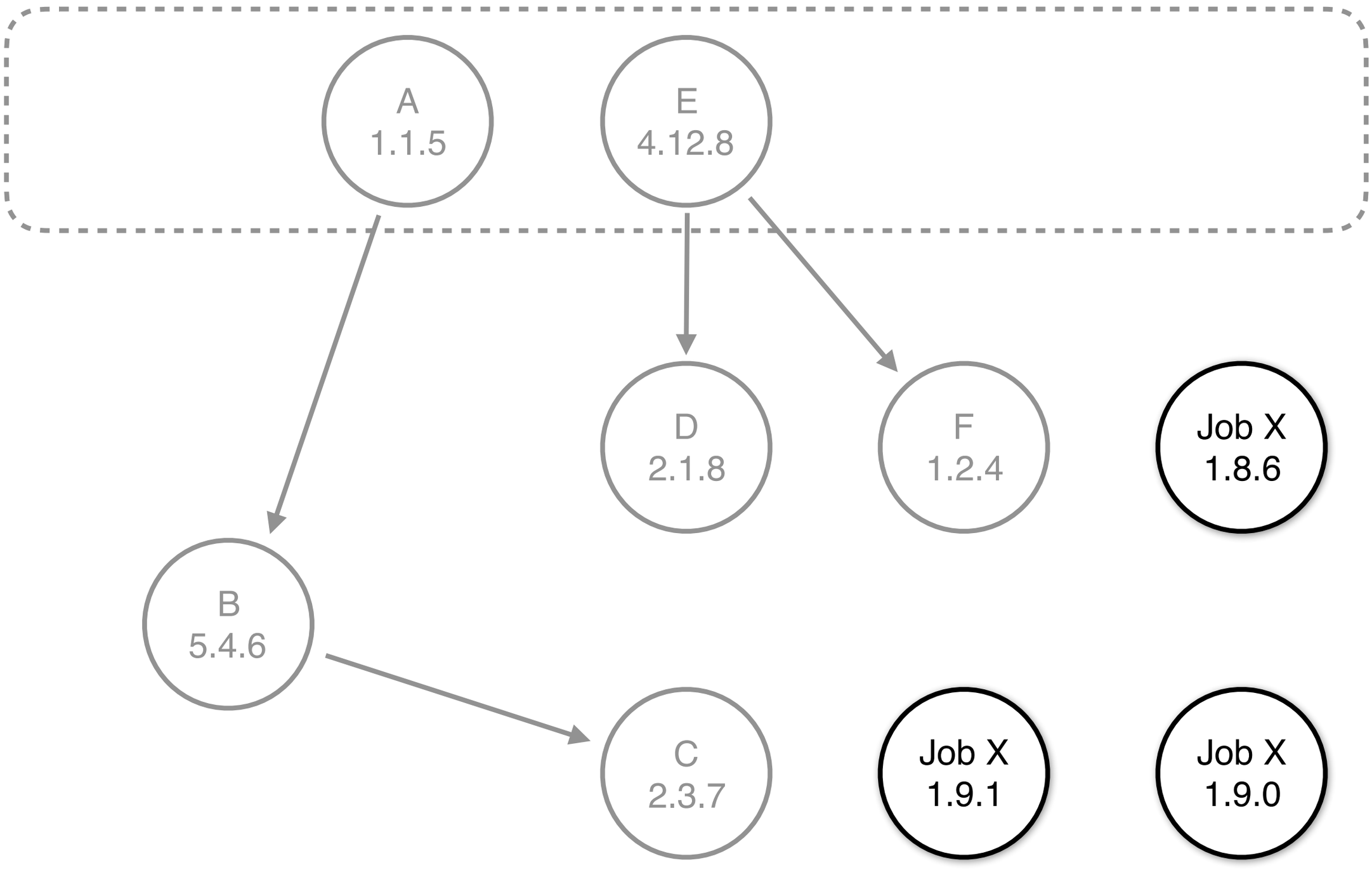
Graph management: pruning



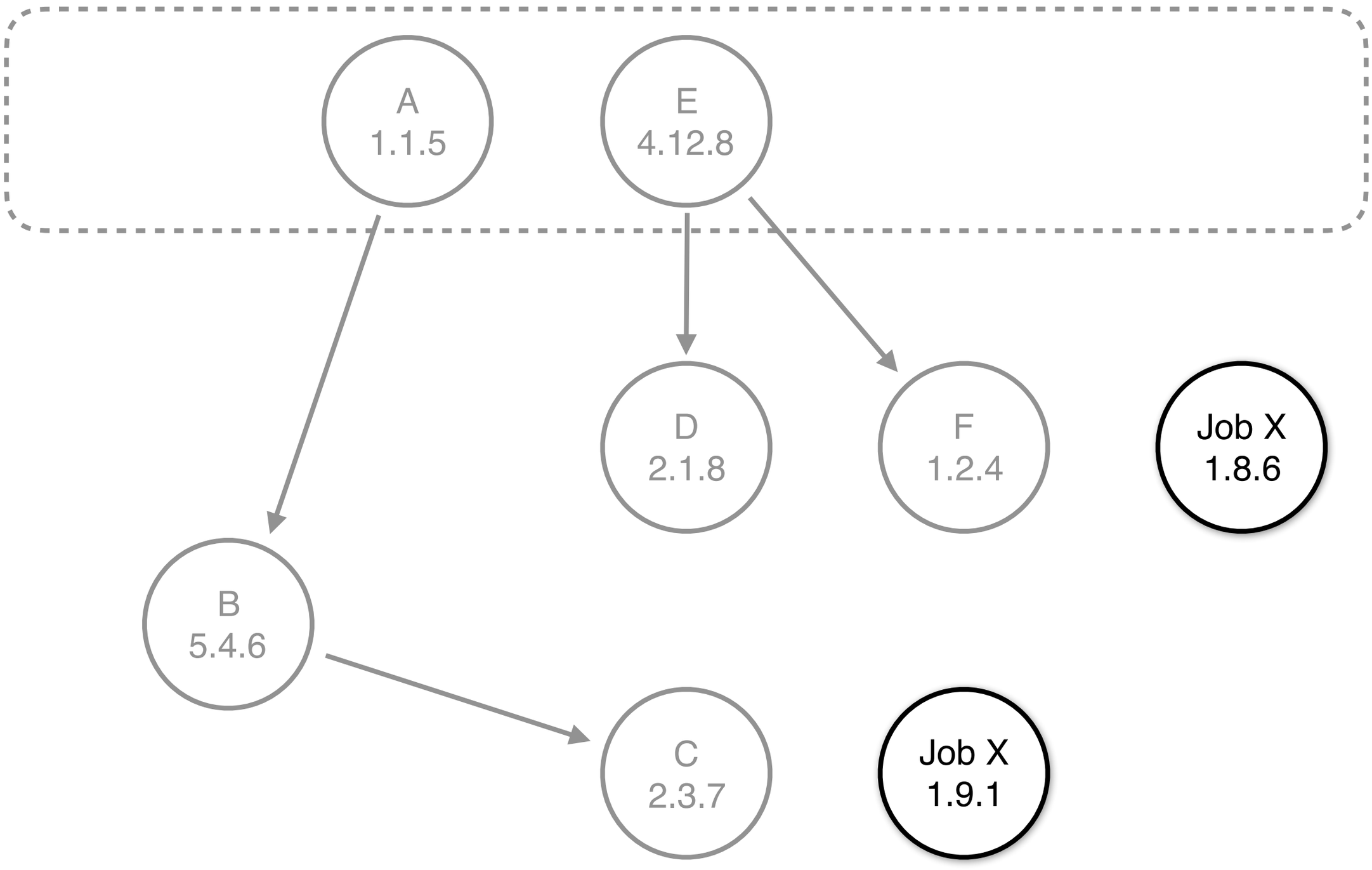
Graph management: pruning

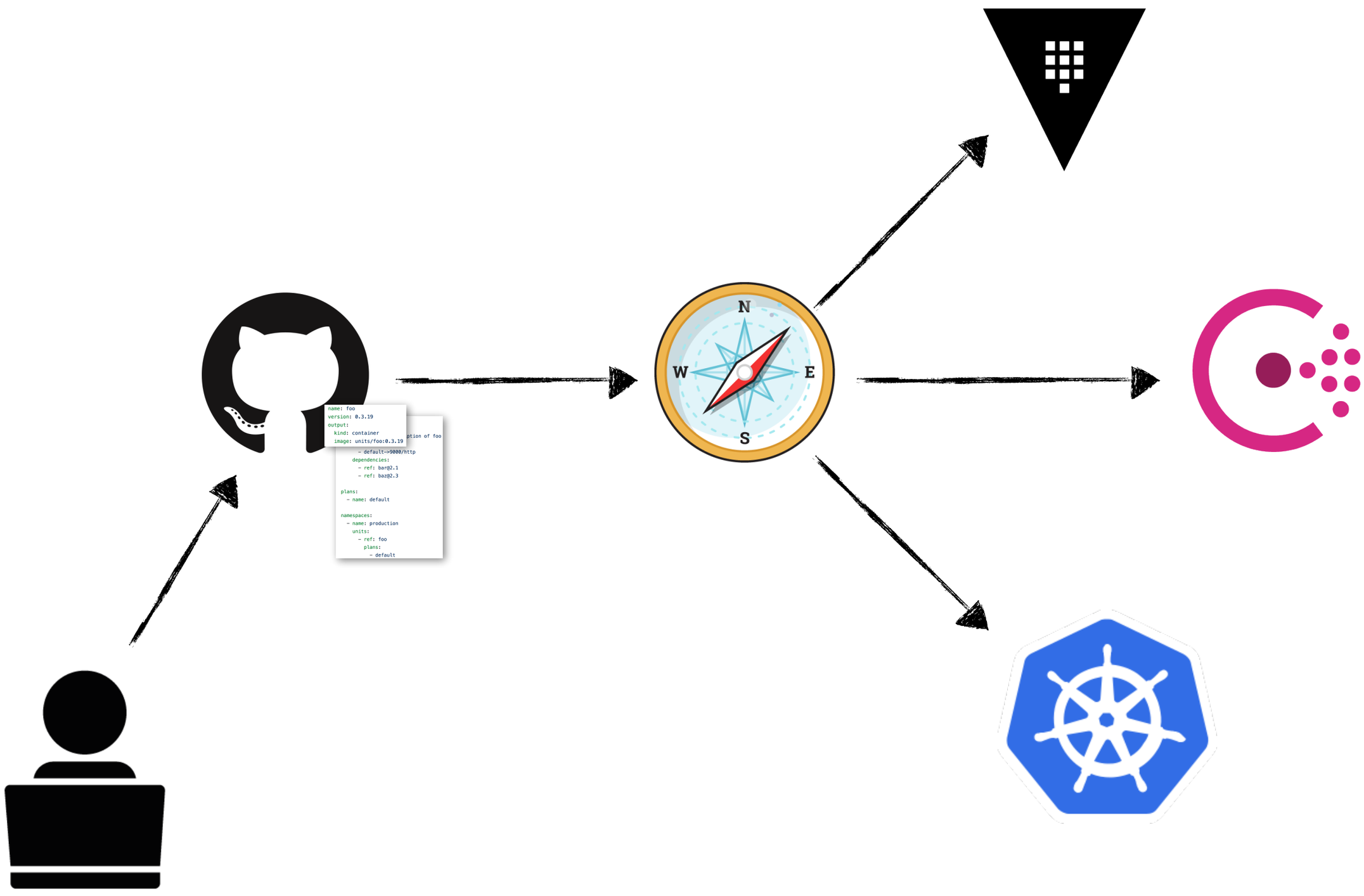


Graph management: pruning



Graph management: pruning




name: foo
version: 0.3.19
output:
kind: container
image: units/foo:0.3.19
- default->9000/http
dependencies:
- ref: bar@2.1
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default
N
W
E
S

Launch workflow

```
for {
    _  <- status(id, Pending, "workflow about to start")
    i  <- dockerOps(id, unit, dc.docker.registry)
```

Launch workflow

```
for {
    _  <- status(id, Pending, "workflow about to start")
    i  <- dockerOps(id, unit, dc.docker.registry)

    _  <- status(id, Deploying, s"writing alert definitions to ${dc.name}'s consul")
    _  <- writeAlertsToConsul(sn, ns.name, p.name, unit, p.environment.alertOptOuts)
```

Launch workflow

```
for {
    _  <- status(id, Pending, "workflow about to start")
    i  <- dockerOps(id, unit, dc.docker.registry)

    _  <- status(id, Deploying, s"writing alert definitions to ${dc.name}'s consul")
    _  <- writeAlertsToConsul(sn, ns.name, p.name, unit, p.environment.alertOptOuts)

    _  <- logToFile(...)
    _  <- writePolicyToVault(cfg = dc.policy, sn = sn, ns = ns.name, rs = rs)
```

Launch workflow

```
for {
    _  <- status(id, Pending, "workflow about to start")
    i  <- dockerOps(id, unit, dc.docker.registry)

    _  <- status(id, Deploying, s"writing alert definitions to ${dc.name}'s consul")
    _  <- writeAlertsToConsul(sn, ns.name, p.name, unit, p.environment.alertOptOuts)

    _  <- logToFile(...)
    _  <- writePolicyToVault(cfg = dc.policy, sn = sn, ns = ns.name, rs = rs)

    _  <- logToFile(...)
    _  <- writeDiscoveryToConsul(id, sn, ns.name, dc)
```

Launch workflow

```
for {
    _  <- status(id, Pending, "workflow about to start")
    i  <- dockerOps(id, unit, dc.docker.registry)

    _  <- status(id, Deploying, s"writing alert definitions to ${dc.name}'s consul")
    _  <- writeAlertsToConsul(sn, ns.name, p.name, unit, p.environment.alertOptOuts)

    _  <- logToFile(...)
    _  <- writePolicyToVault(cfg = dc.policy, sn = sn, ns = ns.name, rs = rs)

    _  <- logToFile(...)
    _  <- writeDiscoveryToConsul(id, sn, ns.name, dc)

    _  <- getTrafficShift.cata(...)
    _  <- logToFile(...)
```

Launch workflow

```
for {
    _  <- status(id, Pending, "workflow about to start")
    i  <- dockerOps(id, unit, dc.docker.registry)

    _  <- status(id, Deploying, s"writing alert definitions to ${dc.name}'s consul")
    _  <- writeAlertsToConsul(sn, ns.name, p.name, unit, p.environment.alertOptOuts)

    _  <- logToFile(...)
    _  <- writePolicyToVault(cfg = dc.policy, sn = sn, ns = ns.name, rs = rs)

    _  <- logToFile(...)
    _  <- writeDiscoveryToConsul(id, sn, ns.name, dc)

    _  <- getTrafficShift.cata(...)
    _  <- logToFile(...)

    l  <- launch(i, dc, ns.name, vunit, p, hash)
    _  <- debug(s"response from scheduler $l")
```

Launch workflow

```
for {
    _  <- status(id, Pending, "workflow about to start")
    i  <- dockerOps(id, unit, dc.docker.registry)

    _  <- status(id, Deploying, s"writing alert definitions to ${dc.name}'s consul")
    _  <- writeAlertsToConsul(sn, ns.name, p.name, unit, p.environment.alertOptOuts)

    _  <- logToFile(...)
    _  <- writePolicyToVault(cfg = dc.policy, sn = sn, ns = ns.name, rs = rs)

    _  <- logToFile(...)
    _  <- writeDiscoveryToConsul(id, sn, ns.name, dc)

    _  <- getTrafficShift.cata(...)
    _  <- logToFile(...)

    l  <- launch(i, dc, ns.name, vunit, p, hash)
    _  <- debug(s"response from scheduler $l")

    _  <- status(id, getStatus(unit, p), "======> workflow completed <======")
} yield ()
```

Delete workflow

```
logToFile(d.id, s"removing policy from vault: ${vaultLoggingFields(...)}") >>
deletePolicyFromVault(d.stackName, ns.name) >>
```

Delete workflow

```
logToFile(d.id, s"removing policy from vault: ${vaultLoggingFields(...)}") >>
deletePolicyFromVault(d.stackName, ns.name) >>

logToFile(d.id, s"removing alerts from consul ${alerts.alertingKey(sn)}") >>
deleteAlertsFromConsul(d.stackName) >>
```

Delete workflow

```
logToFile(d.id, s"removing policy from vault: ${vaultLoggingFields(...)}") >>
deletePolicyFromVault(d.stackName, ns.name) >>

logToFile(d.id, s"removing alerts from consul ${alerts.alertingKey(sn)}") >>
deleteAlertsFromConsul(d.stackName) >>

logToFile(d.id, ...) >>
deleteDiscoveryInfoFromConsul(sn) >>
```

Delete workflow

```
logToFile(d.id, s"removing policy from vault: ${vaultLoggingFields(...)}") >>
deletePolicyFromVault(d.stackName, ns.name) >>

logToFile(d.id, s"removing alerts from consul ${alerts.alertingKey(sn)}") >>
deleteAlertsFromConsul(d.stackName) >>

logToFile(d.id, ...) >>
deleteDiscoveryInfoFromConsul(sn) >>

logToFile(d.id, s"instructing ${dc.name}'s scheduler to decommission ${sn}") >>
delete(dc,d) >>
```

Delete workflow

```
logToFile(d.id, s"removing policy from vault: ${vaultLoggingFields(...)}") >>
deletePolicyFromVault(d.stackName, ns.name) >>

logToFile(d.id, s"removing alerts from consul ${alerts.alertingKey(sn)}") >>
deleteAlertsFromConsul(d.stackName) >>

logToFile(d.id, ...) >>
deleteDiscoveryInfoFromConsul(sn) >>

logToFile(d.id, s"instructing ${dc.name}'s scheduler to decommission ${sn}") >>
delete(dc,d) >>

status(d.id, Terminated, s"Decommissioning deployment ${sn} in ${dc.name}")
```

Background processes

```
runBackgroundJob("auditor", cfg.auditor.process(cfg.storage))
```

Background processes

```
runBackgroundJob("auditor", cfg.auditor.process(cfg.storage))

runBackgroundJob("pipeline_processor",
                 Process.eval(Pipeline.task(cfg)(Pipeline.sinks.runAction(cfg))))
```

Background processes

```
runBackgroundJob("auditor", cfg.auditor.process(cfg.storage))

runBackgroundJob("pipeline_processor",
                 Process.eval(Pipeline.task(cfg)(Pipeline.sinks.runAction(cfg))))

runBackgroundJob("workflow_logger", cfg.workflowLogger.process)
```

Background processes

```
runBackgroundJob("auditor", cfg.auditor.process(cfg.storage))

runBackgroundJob("pipeline_processor",
                 Process.eval(Pipeline.task(cfg)(Pipeline.sinks.runAction(cfg))))

runBackgroundJob("workflow_logger", cfg.workflowLogger.process)

runBackgroundJob("routing_cron",
                 routing.cron.consulRefresh(cfg) to Http4sConsul.consulSink)
```

Background processes

```
runBackgroundJob("auditor", cfg.auditor.process(cfg.storage))

runBackgroundJob("pipeline_processor",
                 Process.eval(Pipeline.task(cfg)(Pipeline.sinks.runAction(cfg))))

runBackgroundJob("workflow_logger", cfg.workflowLogger.process)

runBackgroundJob("routing_cron",
                 routing.cron.consulRefresh(cfg) to Http4sConsul.consulSink)

runBackgroundJob("cleanup_pipeline", cleanup.CleanupCron.pipeline(cfg))
```

Background processes

```
runBackgroundJob("auditor", cfg.auditor.process(cfg.storage))

runBackgroundJob("pipeline_processor",
                 Process.eval(Pipeline.task(cfg)(Pipeline.sinks.runAction(cfg))))

runBackgroundJob("workflow_logger", cfg.workflowLogger.process)

runBackgroundJob("routing_cron",
                 routing.cron.consulRefresh(cfg) to Http4sConsul.consulSink)

runBackgroundJob("cleanup_pipeline", cleanup.CleanupCron.pipeline(cfg))

runBackgroundJob("sweeper", cleanup.Sweeper.process(cfg))
```

Background processes

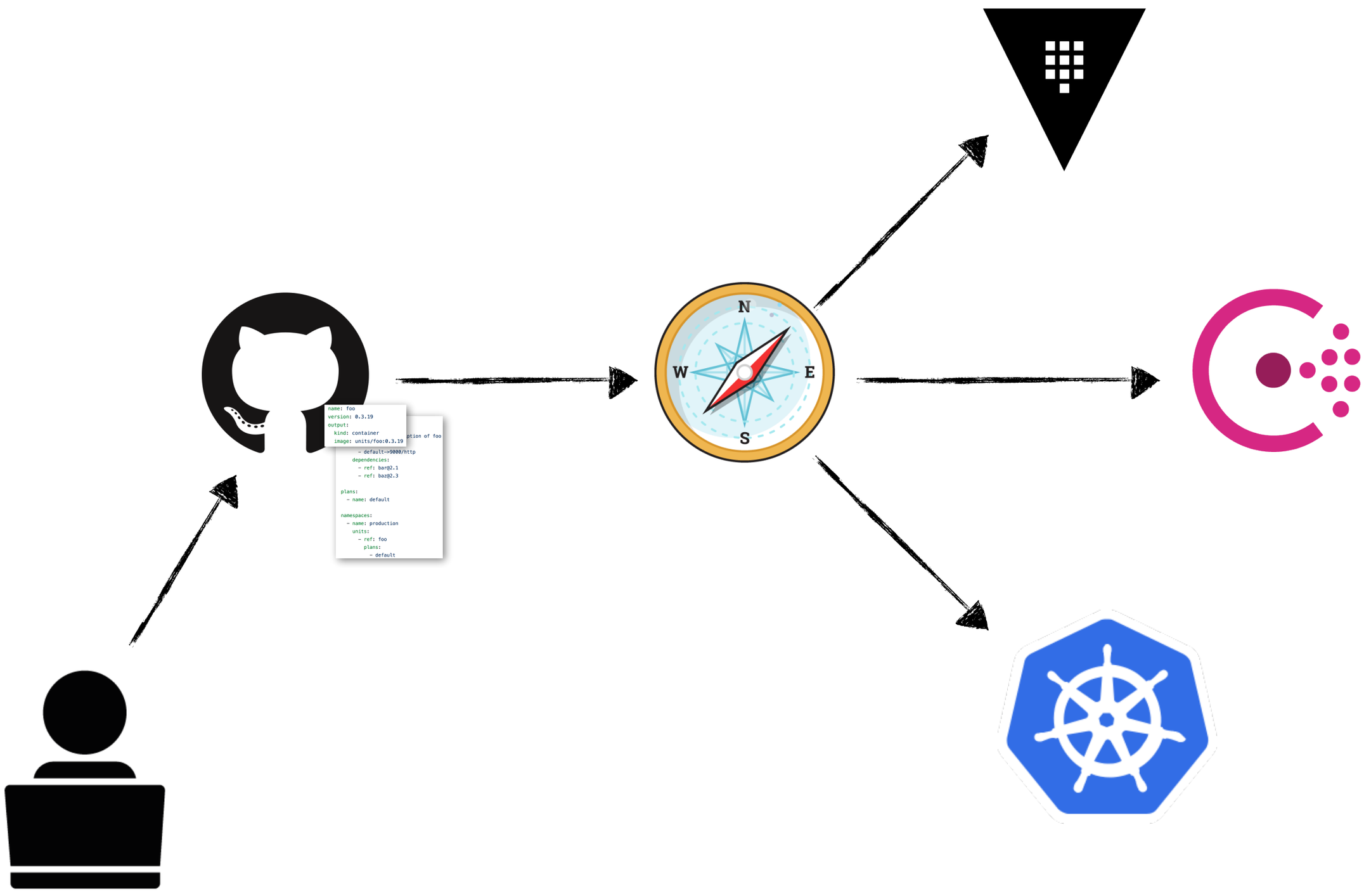
```
runBackgroundJob("auditor", cfg.auditor.process(cfg.storage))

runBackgroundJob("pipeline_processor",
                 Process.eval(Pipeline.task(cfg)(Pipeline.sinks.runAction(cfg))))

runBackgroundJob("workflow_logger", cfg.workflowLogger.process)

runBackgroundJob("routing_cron",
                 routing.cron.consulRefresh(cfg) to Http4sConsul.consulSink)

runBackgroundJob("cleanup_pipeline", cleanup.CleanupCron.pipeline(cfg))

runBackgroundJob("sweeper", cleanup.Sweeper.process(cfg))

runBackgroundJob("deployment_monitor", DeploymentMonitor.loop(cfg))
```

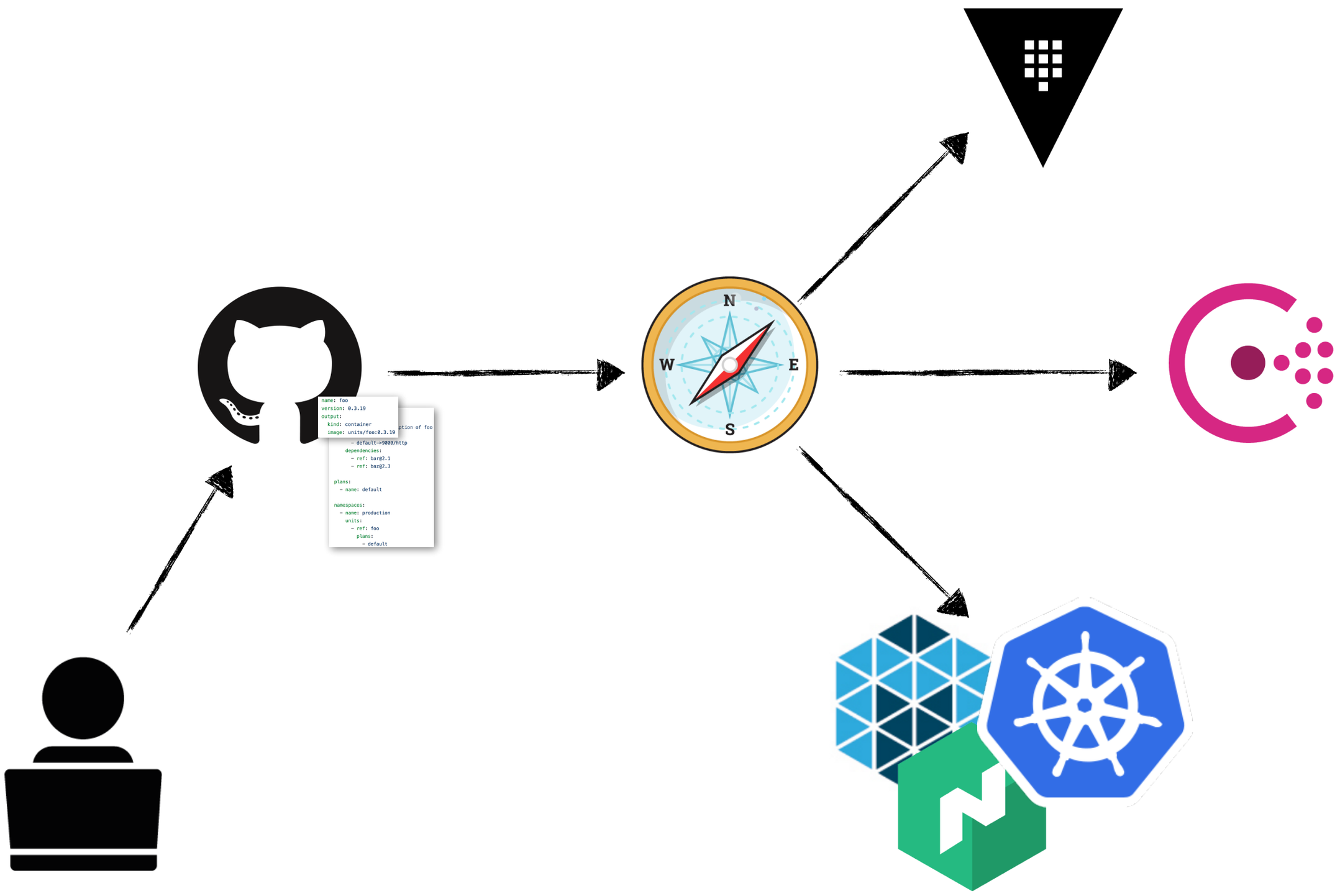
Workflow algebra

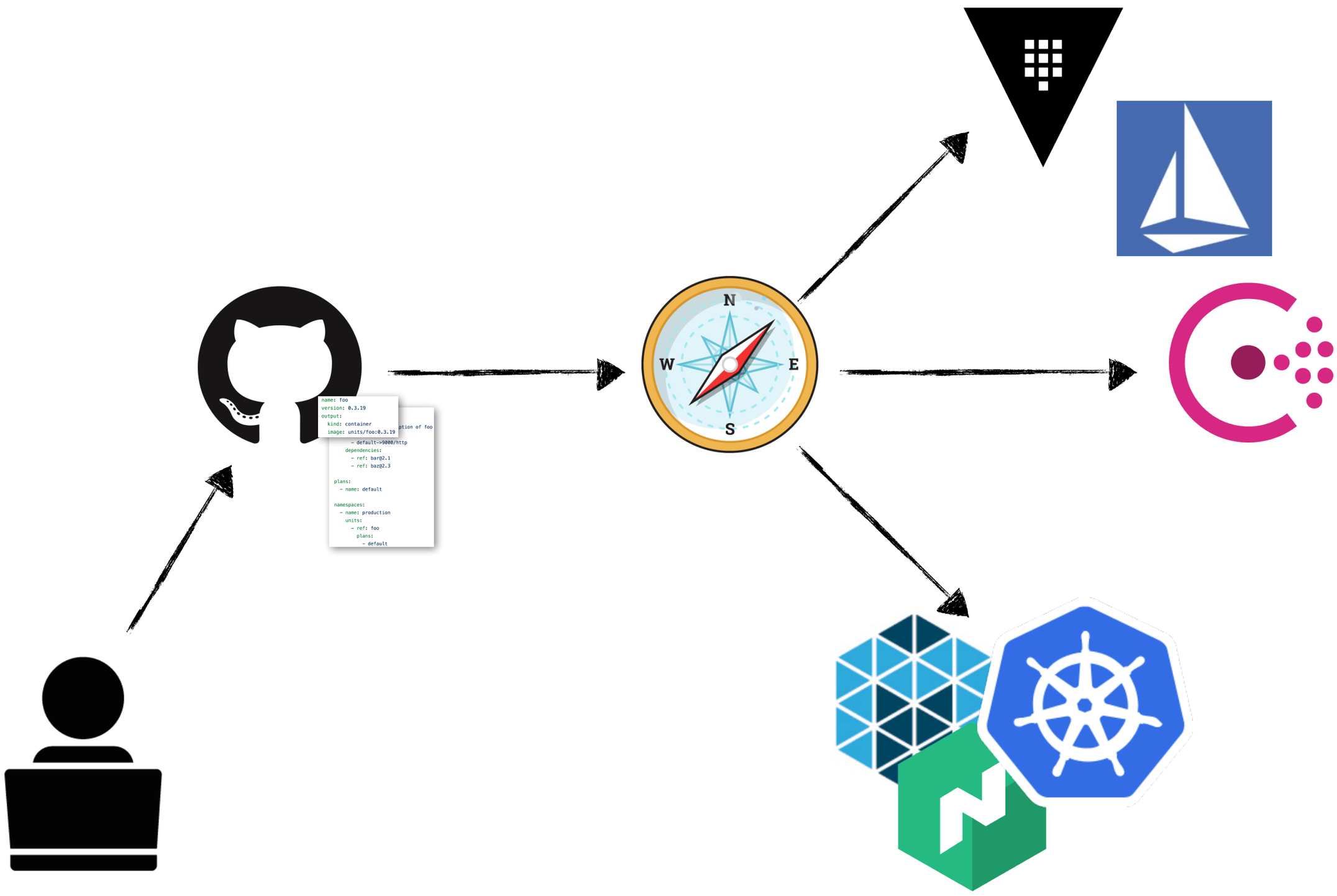
```
type Op0[A] = Coproduct[DockerOp, ConsulOp, A]

type Op1[A] = Coproduct[LoggingOp, Op0,A]

type Op2[A] = Coproduct[StoreOp, Op1, A]

type Op3[A] = Coproduct[WorkflowControlOp, Op2,A]

type Op4[A] = Coproduct[Vault, Op3, A]

type WorkflowOp[A] = Coproduct[SchedulerOp, Op4, A]

type WorkflowF[A] = Free.FreeC[WorkflowOp, A]
```

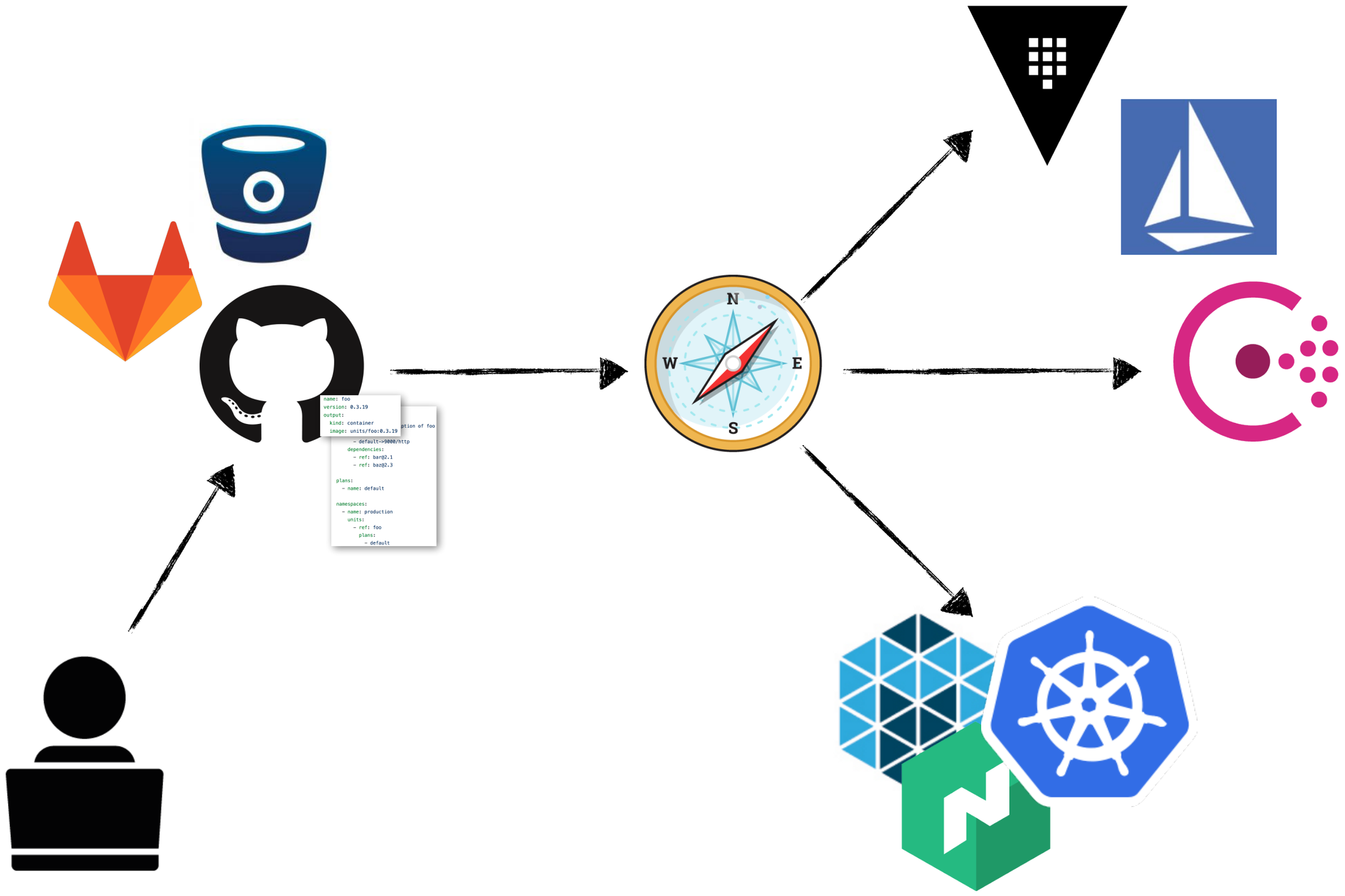
Workflow interpreter(s)

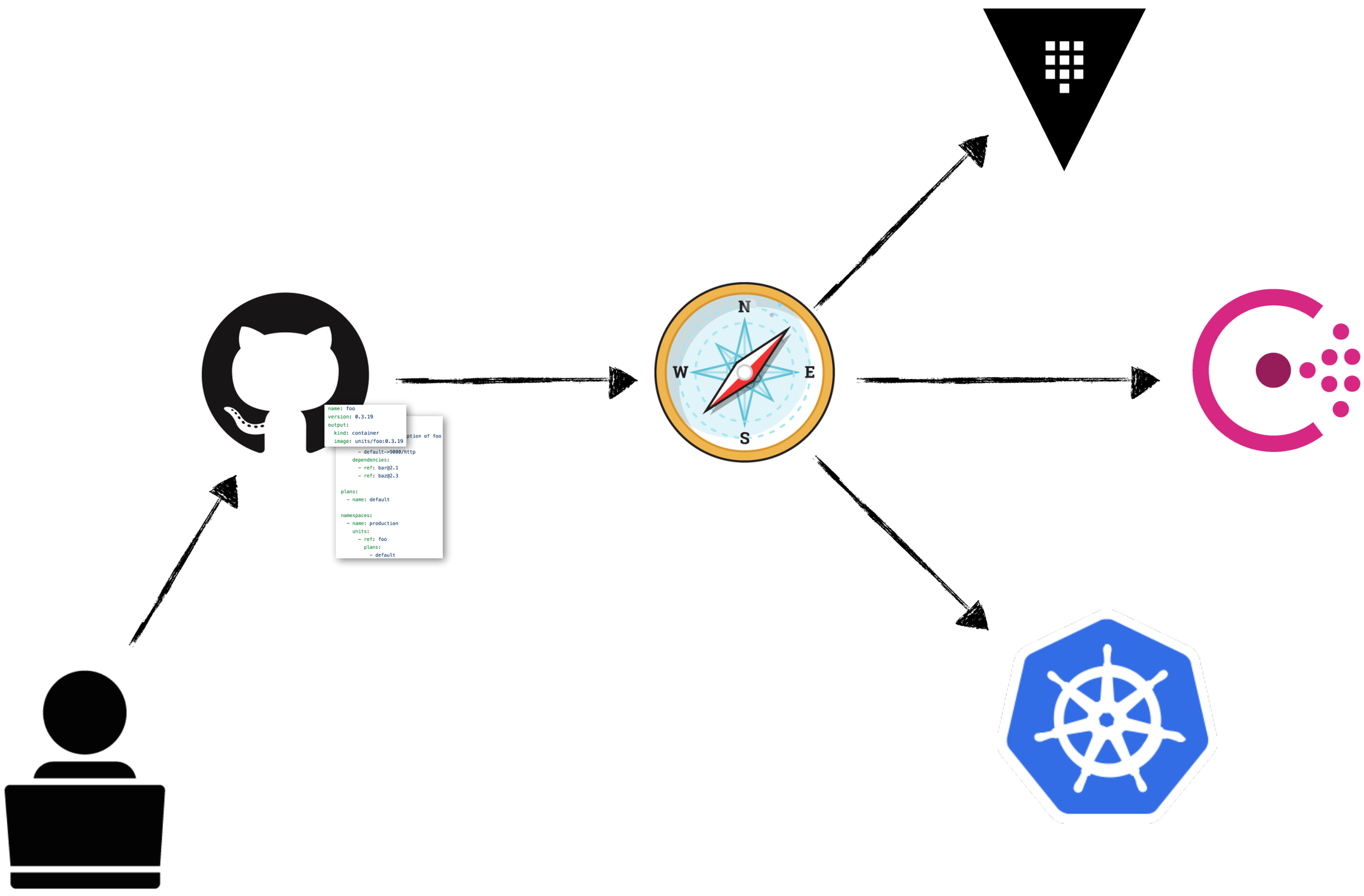
```
final case class Interpreters(
  scheduler: SchedulerOp        ~> Task,
  consul:    ConsulOp           ~> Task,
  vault:     Vault              ~> Task,
  storage:   StoreOp            ~> Task,
  logger:    LoggingOp          ~> Task,
  docker:    DockerOp           ~> Task,
  control:   WorkflowControlOp  ~> Task,
  health:    HealthCheckOp      ~> Task
)
```

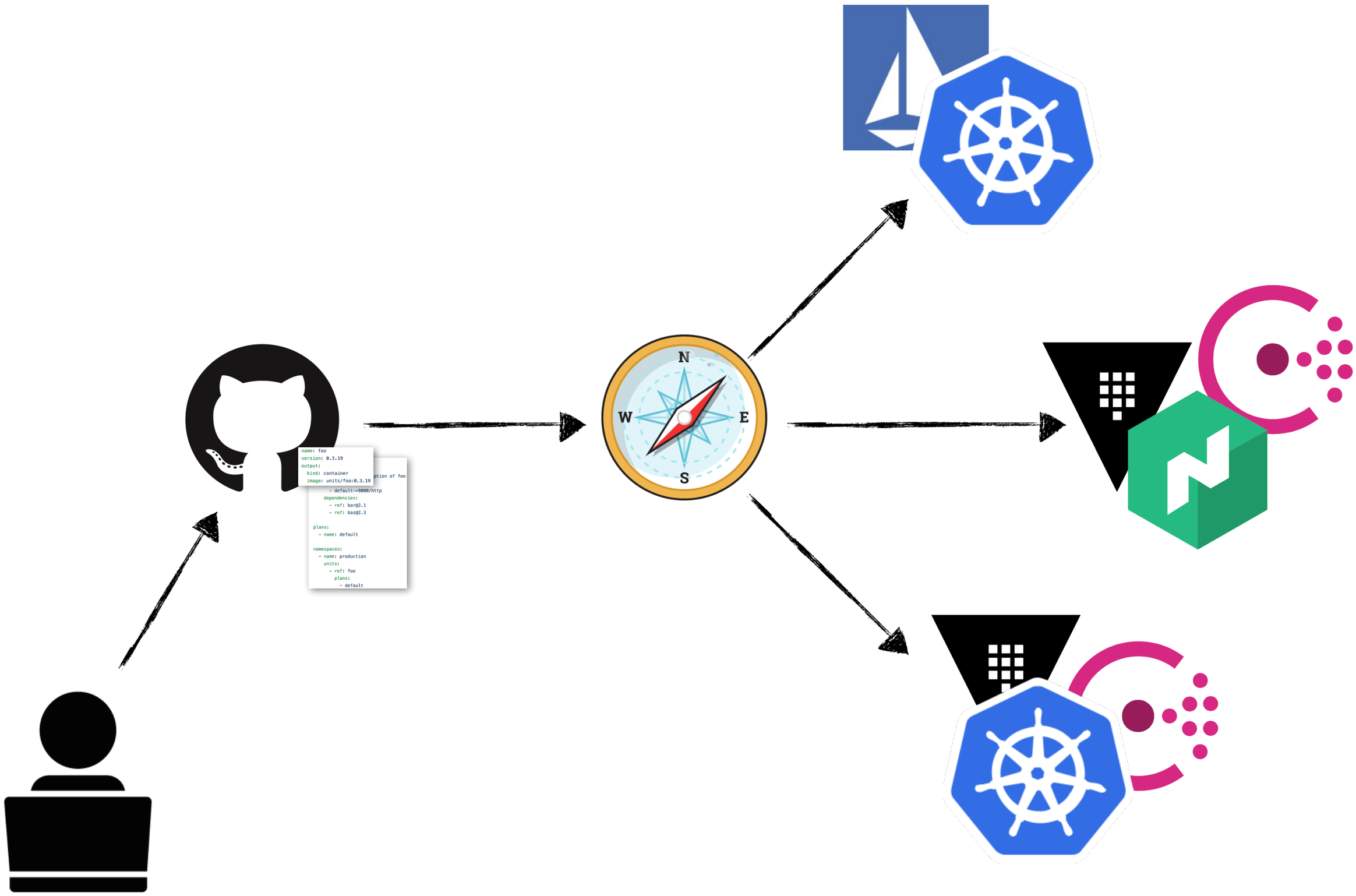

name: foo
version: 0.3.19
output:
kind: container
image: units/foo:0.3.19
- default->9000/http
dependencies:
- ref: bar@2.1
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default
N
W
E
S

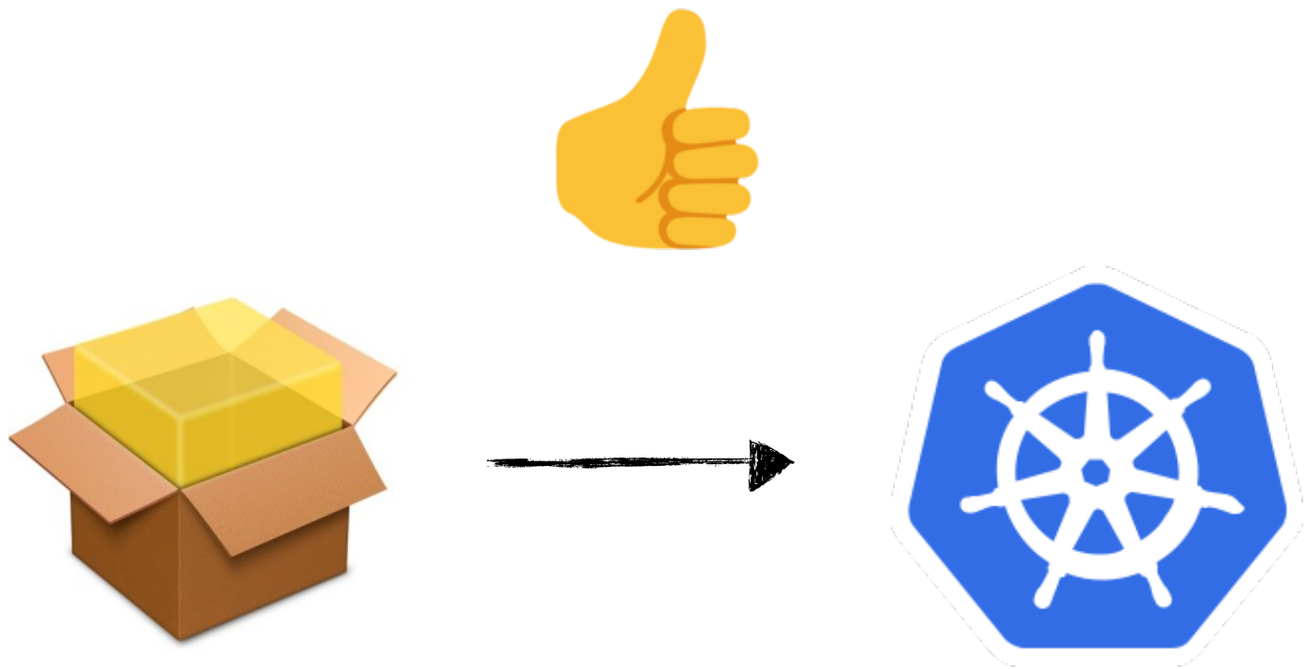

N
W
E
S
name: foo
version: 0.3.19
output:
kind: container
image: units/foo:0.3.19
- default->9000/http
dependencies:
- ref: bar@2.1
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default

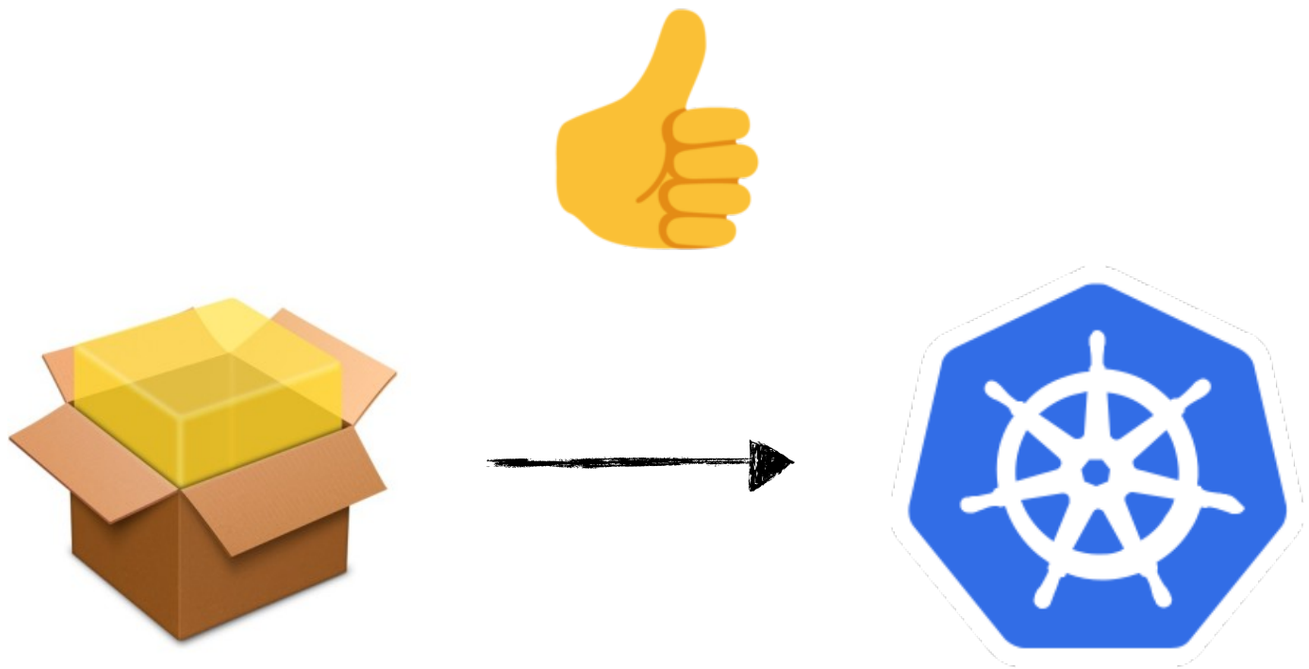

name: foo
version: 0.3.19
output:
kind: container
image: units/foo:0.3.19
- default->9000/http
dependencies:
- ref: bar@2.1
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default
N
W
E
S

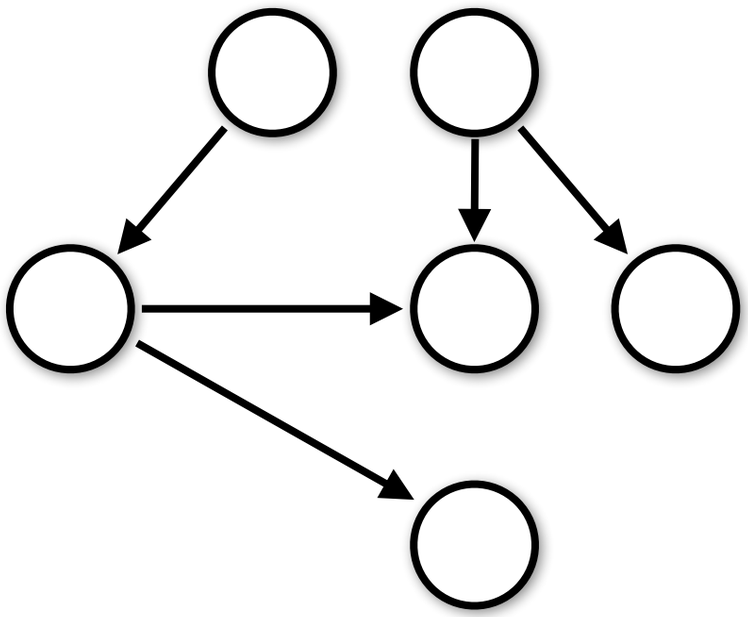

name: foo
version: 0.3.19
output:
kind: container
image: units/foo:0.3.19
- default->9000/http
dependencies:
- ref: bar@2.1
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default
N
W
E
S

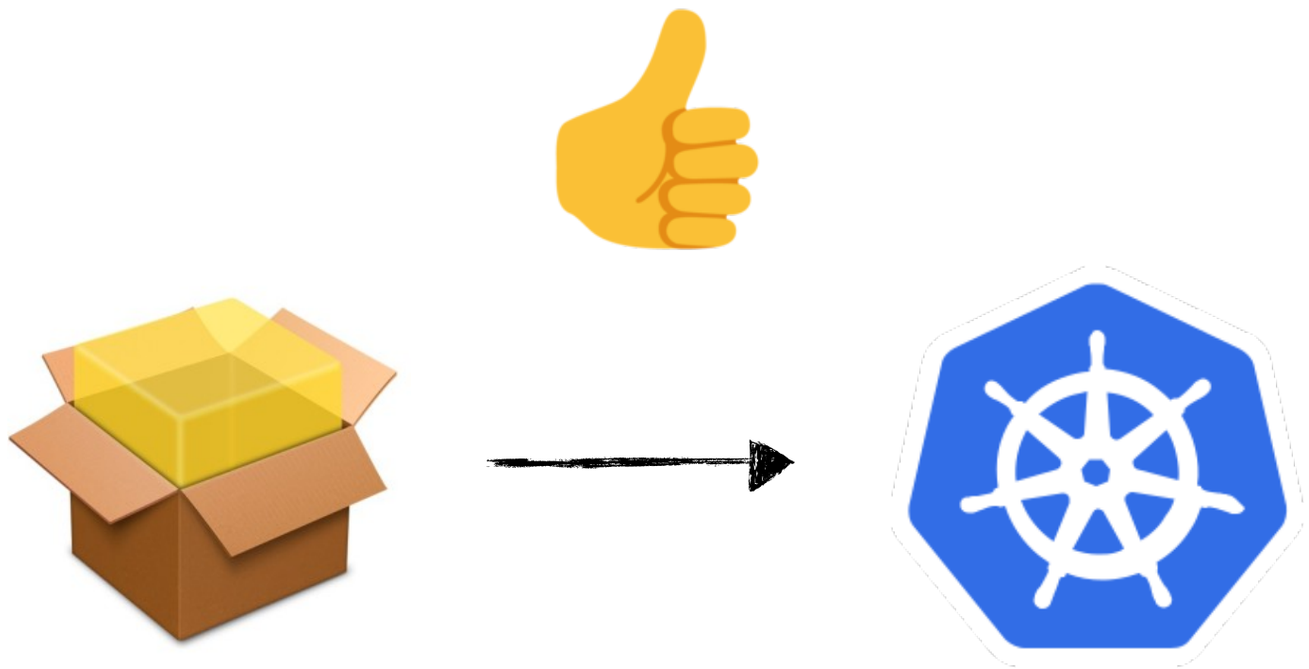

name: foo
version: 0.3.19
output:
kind: container
image: units/foo:0.3.19
- default->9000/http
dependencies:
- ref: bar@2.1
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default
N
W
E
S

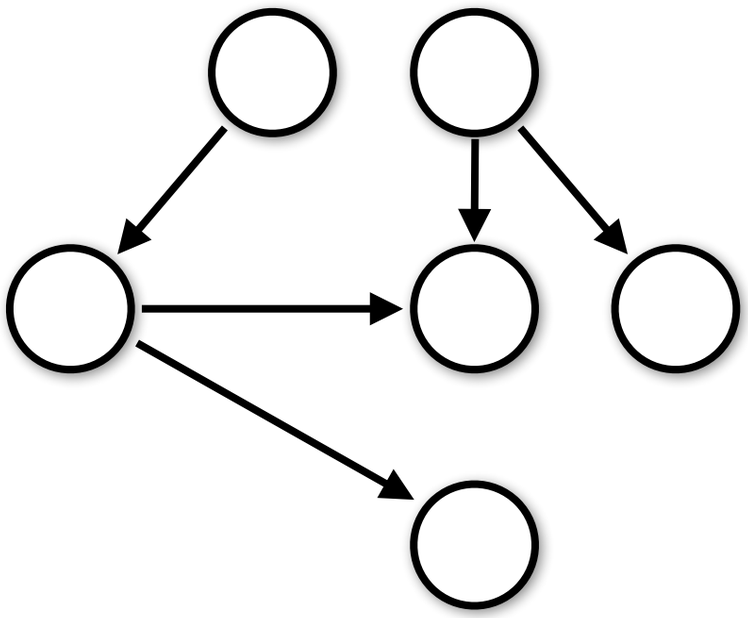

name: foo
version: 0.3.19
output:
kind: container
image: units/foo:0.3.19
- default->9000/http
dependencies:
- ref: bar@2.1
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default
N
W
E
S

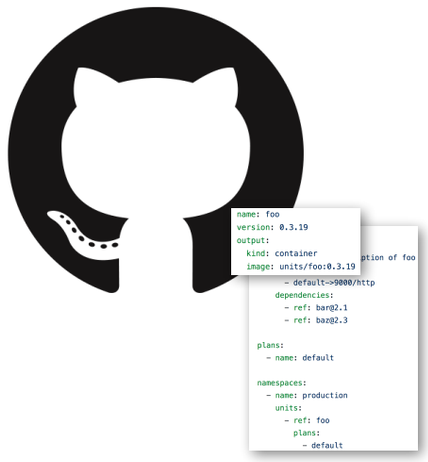








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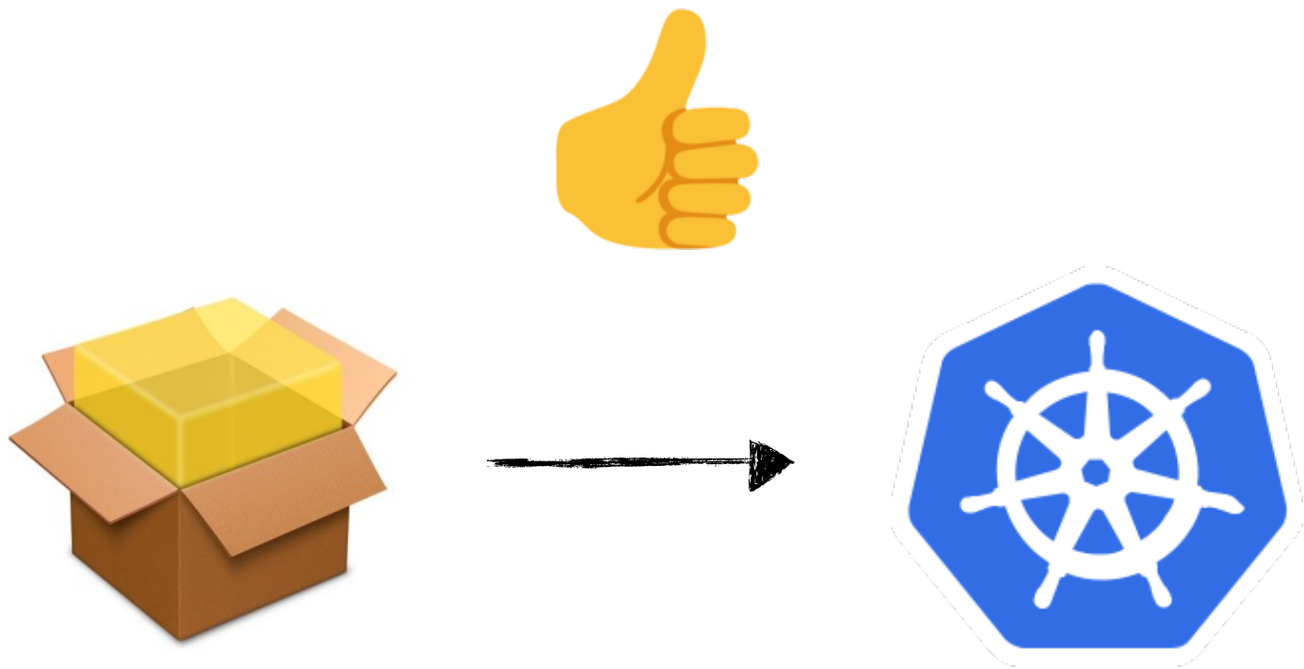
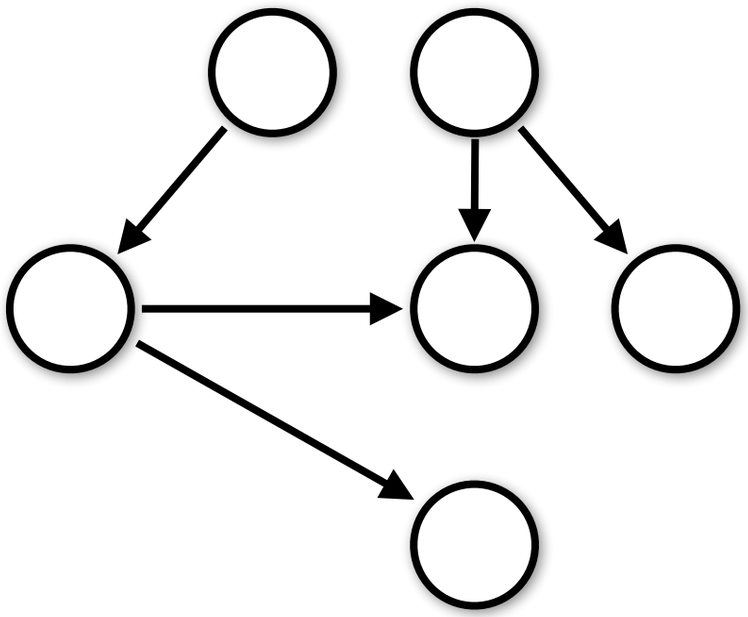
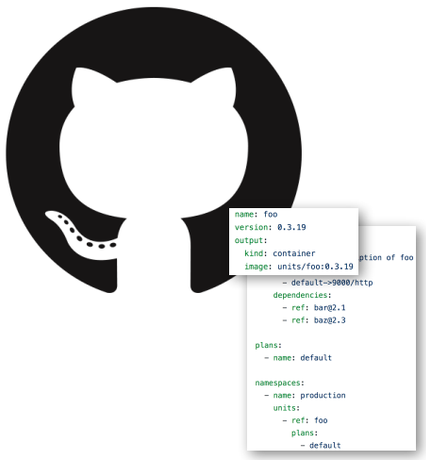
- ref: baz@2.3
plans:
- name: default
namespaces:
- name: production
units:
- ref: foo
plans:
- default



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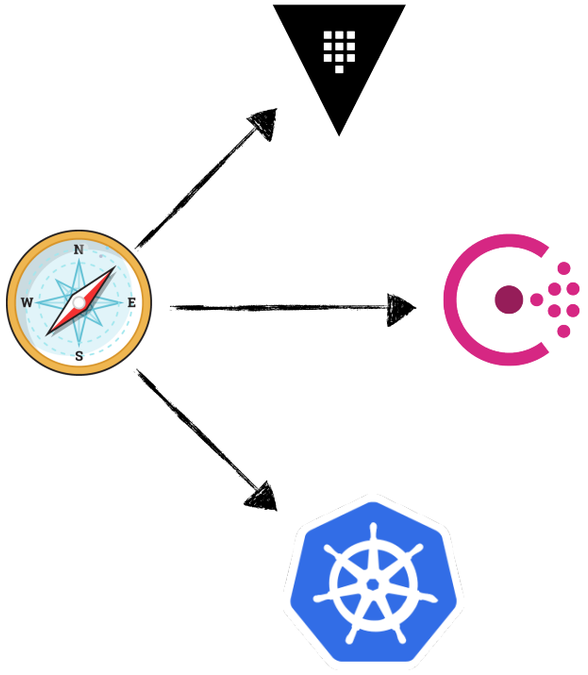
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https://getnelson.github.io/

https://github.com/getnelson/

https://gitter.im/getnelson/nelson