I.

A more literal translation:

persons (<u>ssn</u>, name, dob)

boats (<u>name</u>, tonnage)

ownerships (<u>id</u>, bname, begin, end)
fk bname references boats

coOwners (oid, ssn)
fk oid references ownerships
fk ssn references persons

racesWon (bname, race)
fk bname references boats

A more streamlined one (allows cases the above does not, such as several co-owners of a boat whose ownership intervals overlap but are not identical):

persons (<u>ssn</u>, name, dob)

boats (<u>name</u>, tonnage)

ownerships (ssn, bname, begin, end)
fk bname references boats
fk ssn references persons

racesWon (bname, race)
fk bname references boats

all ODL information is captured (we do not need to introduce a distinct relation for every ODL relationship)

II.1

```
select  struct (boat: b, owner: p)
from    b in boats, p in b.belongedTo.coOwners
where “America’s Cup” in b.racesWon
```

II.2

```
select o.boat from o in ownerships, p in o.coOwners where p.name = “Jack Sparrow”
```

II.3

```
select o.boat
from   p in persons, o in p.ownerships
where p.name = “Jack Sparrow”
```

II.4
“Most recently owned” means that none of his other boats has a more recent ownership end date. Assume that current ownerships have a null end date.

```
select   o.boat
from     p in persons, o in p.ownerships
where  p.name = “Jack Sparrow” and
           (o.end = null or
            for all o1 in p.ownerships: o.end >= o1.end)
```

II.5

```
select p
from  persons p
where for all b in (select w from w in boats where “America’s Cup” in w.racesWon):
                    p in b.belongedTo.coOwners
```

III. Working on the streamlined schema, to reduce number of joins.

II.1

racesWon | bname | race
| _b | “America’s Cup”

ownerships | bname | ssn | begin | end
| _b | _o | |

result | boat | owner
I. | _b | _o

II.2

persons | ssn | name | dob
| _s | “Jack Sparrow” |

ownerships | bname | ssn | begin | end
| _b | _s | |

result | boat
I. | _b

II.4

Stage (i):

boats | name | tonnage
| _b |
| _o |

persons | ssn | name | dob
| _s | “Jack Sparrow” |

ownerships | bname | ssn | begin | end
| _b | _s | | _be
| _o | _s | | _oe

condition box: _be != null and (_oe = null or _oe > _be)

notMostRecent | boat
I. | _b

Stage (ii):

persons | ssn | name | dob
| _s | “Jack Sparrow” |

ownerships | bname | ssn | begin | end
| _b | _s | |

notMostRecent | boat
¬ | _b

result | boat
I. | _b

II.5

Stage (i):

racesWon | bname | race
| _b | “America’s Cup”

persons | ssn | name | dob
| _s | |

ownerships | bname | ssn | begin | end
¬ | _b | _s | |

missedSome | ssn
I. | _s

Stage (ii):

persons | ssn | name | dob
| _s | |

missedSome | ssn
¬ | _s

result | ssn
I. | _s