University of British Columbia, Vancouver
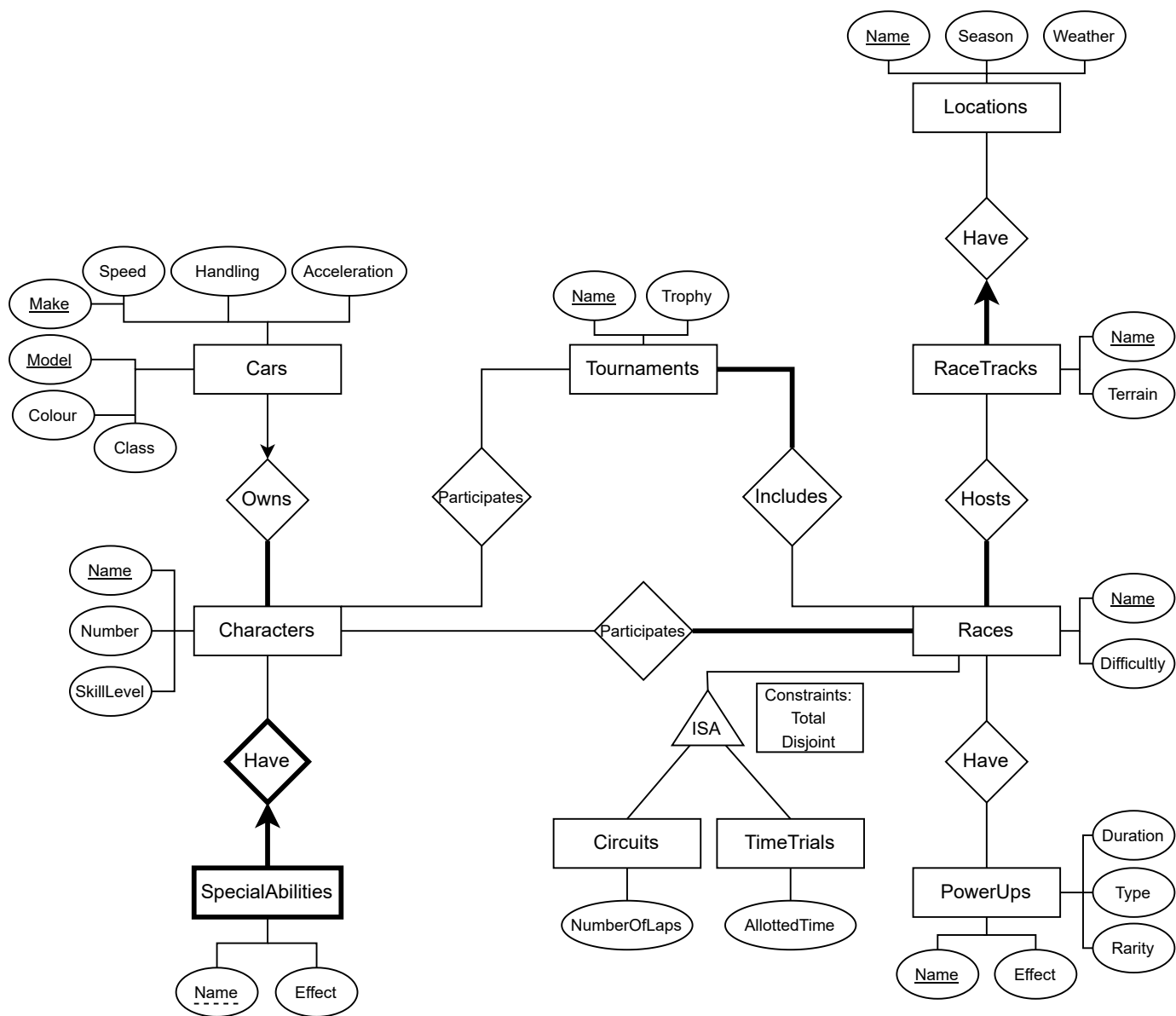Department of Computer Science

CPSC 304 Project Cover Page

Milestone #: 2

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Group Number: 36

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By typing our names and student numbers in the above table, we certify that the work in the attached assignment was performed solely by those whose names and student IDs are included above. (In the case of Project Milestone 0, the main purpose of this page is for you to let us know your e-mail address, and then let us assign you to a TA for your project supervisor.)

In addition, we indicate that we are fully aware of the rules and consequences of plagiarism, as set forth by the Department of Computer Science and the University of British Columbia

Locations

- <u>Name</u>
- Season
- Weather

Cars

- <u>Make</u>
- <u>Model</u>
- Colour
- Class
- Speed
- Handling
- Acceleration

Tournaments

- <u>Name</u>
- Trophy

RaceTracks

- <u>Name</u>
- Terrain

Have

Owns

Participates

Includes

Hosts

Characters

- <u>Name</u>
- Number
- SkillLevel

Participates

Races

- <u>Name</u>
- Difficultly

Have

SpecialAbilities

- <u>Name</u>
- Effect

ISA

Constraints:
Total
Disjoint

Have

Circuits

- NumberOfLaps

TimeTrials

- AllottedTime

PowerUps

- Duration
- Type
- Rarity
- <u>Name</u>
- Effect

2. ER Diagram Changes

(1) Added Season as an attribute for Locations.

Locations only have one season to resemble real life where race tracks are only open during certain seasons.

Locations only have one weather to resemble old racing games that featured locations with one weather.

(2) Added Type as an attribute for PowerUps to better classify effects.

3. Relational Schema

Cars (<u>Make</u>: string, <u>Model</u>: string, Colour: string, Class: string, Speed: int, Handling: int, Acceleration: int, **CharacterName**: string)

Characters (<u>Name</u>: string, Number: int, SkillLevel: string) (Number needs to be unique)
CKs: Number

SpecialAbilities (<u>Name</u>: string, Effect: string, **<u>CharacterName</u>**: string)
(CharacterName cannot be null)

Tournaments (<u>Name</u>: string, Trophy: string) (Trophy needs to be unique)
CKs: Trophy

Races (<u>Name</u>: string, Difficulty: string)

Circuits (**<u>RaceName</u>**: string, NumberOfLaps: int)

TimeTrials (**<u>RaceName</u>**: string, AllotedTime: int)

Locations (<u>Name</u>: string, Season: string, Weather: string)

RaceTracks (<u>Name</u>: string, Terrain: string, **LocationName**: string)
(LocationName cannot be null)

PowerUps (<u>Name</u>: string, Effect: string, Duration: int, Rarity: string, Type: string)

CharactersParticipateInRaces (**<u>CharacterName</u>**: string, **<u>RaceName</u>**: string)
(total participation constraint needs to be done with assertion)

CharactersParticipateInTournaments (**<u>CharacterName</u>**: string, **<u>TournamentName</u>**: string)

TournamentsIncludeRaces (**TournamentName**: string, **RaceName**: string)
(total participation constraint needs to be done with assertion)

RaceTracksHostRaces (**RaceTrackName**: string, **RaceName**: string)
(total participation constraint needs to be done with assertion)

RacesHavePowerUps (**RaceName**: string, **PowerUpName**: string)

4. Functional Dependencies

Cars:
Make, Model → Colour, Class, Speed, Handling, Acceleration, CharacterName
Note: Model → Make is not a FD because cars can exist that have the same model but different makes (i.e. Ferrari GTO and Pontiac GTO)

Characters:
CharacterName → Number, SkillLevel
Number → CharacterName

SpecialAbilites:
SpecialAbilityName → Effect, CharacterName

Tournaments:
TournamentName → Trophy
Trophy → TournamentName

Races:
Name → Difficulty

Circuits:
RaceName → NumberOfLaps

TimeTrials:
RaceName → AllotedTime

Locations:
LocationName → Season, Weather
Season → Weather

RaceTracks:
RaceTrackName → Terrain, LocationName

PowerUps:
PowerUpName → Effect, Duration, Rarity, Type
Effect → Type

5. Normalization

Tables not in BCNF:

(1)
Locations(<u>Name</u>, Season, Weather)
Name → Season, Weather
Season → Weather

Locations is not in BCNF because Season is not a superkey.

To transform Locations into BCNF, we first decompose on Season → Weather which gives us two relations Locations$_1$(<u>Season</u>, Weather) and Locations$_2$(<u>Name</u>, **Season**).

We now have two relations Locations$_1$ and Locations$_2$ each with two attributes which completes the decomposition to BCNF.

(2)
PowerUps (<u>Name</u>, Effect, Duration, Rarity, Type)
Name → Effect, Duration, Rarity, Type)
Effect -> Type

This relation PowerUps is not in BCNF because Effect is not a superkey.

We firstly decompose on Effect -> Type, and we get two new relations
PowerUps$_1$(<u>Name</u>, **Effect**, Duration, Rarity) and PowerUps$_2$(<u>Effect</u>, Type)

Tables after normalization:

Cars (<u>Make</u>: string, <u>Model</u>: string, Colour: string, Class: string, Speed: int, Handling: int, Acceleration: int, **CharacterName**: string)

Characters (<u>Name</u>: string, Number: int, SkillLevel: string) (Number needs to be unique)
CKs: Number

SpecialAbilities (<u>Name</u>: string, Effect: string, **<u>CharacterName</u>**: string)
(CharacterName cannot be null)

Tournaments (<u>Name</u>: string, Trophy: string) (Trophy needs to be unique)
CKs: Trophy

Races (<u>Name</u>: string, Difficulty: string)

Circuits (**<u>RaceName</u>**: string, NumberOfLaps: int)

TimeTrials (**<u>RaceName</u>**: string, AllotedTime: int)

Locations$_1$ (<u>Name</u>: string, **Season**: string)

Locations$_2$ (<u>Season</u>: string, Weather: string)

RaceTracks (<u>Name</u>: string, Terrain: string, **LocationName**: string)
(locationName cannot be null)

PowerUps$_1$ (<u>Name</u>: string, **Effect**: string, Duration: int, Rarity: string)

PowerUps$_2$ (<u>Effect</u>: string, Type: string)

CharactersParticipateInRaces (**<u>CharacterName</u>**: string, **<u>RaceName</u>**: string)
(total participation constraint needs to be done with assertion)

CharactersParticipateInTournaments (**<u>CharacterName</u>**: string, **<u>TournamentName</u>**: string)

TournamentsIncludeRaces (**<u>TournamentName</u>**: string, **<u>RaceName</u>**: string)
(total participation constraint needs to be done with assertion)

RaceTracksHostRaces (**<u>RaceTrackName</u>**: string, **<u>RaceName</u>**: string)
(total participation constraint needs to be done with assertion)

RacesHavePowerUps (**<u>RaceName</u>**: string, **<u>PowerUpName</u>**: string)

6. SQL DDL statements

```sql
CREATE TABLE Cars(
    Make            char(30),
    Model           char(30),
    Colour          char(20),
    Class           char(30),
    Speed           int,
    Handling        int,
```

```sql
    Acceleration      int,
    CharacterName     char(30),
    PRIMARY KEY (Make, Model)
    FOREIGN KEY (CharacterName) REFERENCES Characters(Name)
    ON UPDATE CASCADE
);

CREATE TABLE Characters(
    Name             char(30) PRIMARY KEY,
    Number           int UNIQUE,
    SkillLevel       int
);

CREATE TABLE SpecialAbilites(
    Name             char(30) PRIMARY KEY,
    Effect           char(30),
    Duration         int,
    CharacterName    char(30) NOT NULL,
    FOREIGN KEY (CharacterName) REFERENCES Characters(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

CREATE TABLE Tournaments(
    Name      char(30) PRIMARY KEY,
    Trophy    char(20)
);

CREATE TABLE Races (
    Name         char(30) PRIMARY KEY,
    Difficulty   char(30)
);

CREATE TABLE Circuits (
    RaceName        char(30) PRIMARY KEY,
    NumberOfLaps    int,
    FOREIGN KEY (RaceName) REFERENCES Races(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

CREATE TABLE TimeTrials(
    RaceName         char(30) PRIMARY KEY,
```

```sql
    AllottedTime    int,
    FOREIGN KEY (RaceName) REFERENCES Races(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

CREATE TABLE Locations_1 (
    Name        char(30) PRIMARY KEY,
    Season      char(30)
     FOREIGN KEY (Season) REFERENCES Locations_2(Season)
);

CREATE TABLE Locations_2 (
    Season      char(30) PRIMARY KEY,
    Weather     char(30)
);

CREATE TABLE RaceTracks(
    Name            char(30) PRIMARY KEY,
    Terrain         char(30),
    LocationName    char(30) NOT NULL,
    FOREIGN KEY (LocationName) REFERENCES Location(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

CREATE TABLE PowerUps_1(
    Name        char(30) PRIMARY KEY,
    Effect      char(30),
    Duration    int,
    Rarity      char(30),
    FOREIGN KEY (Effect) REFERENCES PowerUps_2(Effect)
);

CREATE TABLE PowerUps_2(
    Effect    char(30) PRIMARY KEY,
    Type      char(30)
);

CREATE TABLE CharactersParticipateInRaces(
    CharacterName    char(30),
    RaceName         char(30),
    PRIMARY KEY(CharacterName, RaceName)
```

```sql
    FOREIGN KEY CharacterName REFERENCES Characters(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
    FOREIGN KEY (RaceName) REFERENCES Races(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

CREATE TABLE CharactersParticpateInTournaments(
    CharacterName       char(30),
    TournamentName      char(30),
    PRIMARY KEY (CharacterName, TournamentName)
    FOREIGN KEY (CharacterName) REFERENCES Characters(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
    FOREIGN KEY TournamentName REFERENCES Tournaments(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

CREATE TABLE TournamentsIncludeRaces(
    TournamentName      char(30),
    RaceName            char(30),
    PRIMARY KEY (TournamentName, RaceName)
    FOREIGN KEY (TournamentName) REFERENCES Tournaments(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
    FOREIGN KEY (RaceName) REFERENCES Races(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

CREATE TABLE RaceTracksHostRaces(
    RaceTrackName       char(30),
    RaceName            char(30),
    PRIMARY KEY (RaceTrackName, RaceName)
    FOREIGN KEY (RaceTrackName) REFERENCES RaceTracks(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
    FOREIGN KEY (RaceName) REFERENCES Races(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);
```

```sql
CREATE TABLE RacesHavePowerUps(
    RaceName        char(30),
    PowerUpName     char(30),
    PRIMARY KEY (RaceName, PowerUpName),
    FOREIGN KEY (RaceName) REFERENCES Races(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
    FOREIGN KEY (PowerUpName) REFERENCES PowerUps(Name)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);
```

7. Insert statements

```sql
INSERT INTO Cars VALUES("Nissan", "370Z", "White", "Drift", 51, 89, 75,
"Aloy");
INSERT INTO Cars VALUES("BMW", "M4", "Blue", "Sport", 80, 34, 47, "Cloud
Strife");
INSERT INTO Cars VALUES("Mercedes", "SLS", "Silver", "Sport", 88, 48, 50,
"Crash Bandicoot");
INSERT INTO Cars VALUES("Acura", "NSX", "Red", "Drift", 55, 84, 88,
"Isabelle");
INSERT INTO Cars VALUES("Subaru", "WRX", "Purple", "Drift", 75, 77, 76,
"Mario");
INSERT INTO Cars VALUES("Toyota", "GT86", "Turquoise", "Drift", 49, 80, 90,
"Master Chief");
INSERT INTO Cars VALUES("Mercedes", "G-Wagon", "Pink", "Off-Road", 78, 53,
80, "Princess Zelda");
INSERT INTO Cars VALUES("Lamborghini", "Urus", "Yellow", "Off-Road", 80,
42, 87, "Solid Snake");
INSERT INTO Cars VALUES("McLaren", "720S", "Orange", "Sport", 94, 30, 42,
"Sonic the Hedgehog");
INSERT INTO Cars VALUES("Audi", "R8", "Light Blue", "Sport", 85, 52, 40,
"Aloy");
INSERT INTO Cars VALUES("BMW", "X5", "Black", "Off-Road", 68, 75, 80,
"Mario");

INSERT INTO Characters VALUES("Aloy", 1, "Novice");
INSERT INTO Characters VALUES("Cloud Strife", 2, "Proficient");
INSERT INTO Characters VALUES("Crash Bandicoot", 3, "Competent");
```

```
INSERT INTO Characters VALUES("Isabelle", 4,"Novice");
INSERT INTO Characters VALUES("Mario", 5, "Expert");
INSERT INTO Characters VALUES("Master Chief", 6, "Expert");
INSERT INTO Characters VALUES("Princess Zelda", 7, "Proficient");
INSERT INTO Characters VALUES("Solid Snake", 8, "Novice");
INSERT INTO Characters VALUES("Sonic the Hedgehog", 9, "Expert");

INSERT INTO Races VALUES("Circuit 1", "Easy");
INSERT INTO Races VALUES("Circuit 2", "Normal");
INSERT INTO Races VALUES("Circuit 3", "Normal");
INSERT INTO Races VALUES("Circuit 4", "Hard");
INSERT INTO Races VALUES("Circuit 5", "Expert");
INSERT INTO Races VALUES("Time Trial 1", "Easy");
INSERT INTO Races VALUES("Time Trial 2", "Normal");
INSERT INTO Races VALUES("Time Trial 3", "Normal");
INSERT INTO Races VALUES("Time Trial 4", "Hard");
INSERT INTO Races VALUES("Time Trial 5", "Expert");

INSERT INTO Circuits VALUES("Circuit 1", 2);
INSERT INTO Circuits VALUES("Circuit 2", 3);
INSERT INTO Circuits VALUES("Circuit 3", 1);
INSERT INTO Circuits VALUES("Circuit 4", 5);
INSERT INTO Circuits VALUES("Circuit 5", 7);

INSERT INTO TimeTrials VALUES("Time Trial 1", 150);
INSERT INTO TimeTrials VALUES("Time Trial 2", 135);
INSERT INTO TimeTrials VALUES("Time Trial 3", 240);
INSERT INTO TimeTrials VALUES("Time Trial 4", 100);
INSERT INTO TimeTrials VALUES("Time Trial 5", 80);

INSERT INTO Locations_1 VALUES("Germany", "Summer");
INSERT INTO Locations_1 VALUES("Japan", "Winter");
INSERT INTO Locations_1 VALUES("United States", "Autumn");
INSERT INTO Locations_1 VALUES("Brazil", "Summer");
INSERT INTO Locations_1 VALUES("United Kingdom", "Spring");
INSERT INTO Locations_1 VALUES("France", "Summer");
INSERT INTO Locations_1 VALUES("Belgium", "Winter");

INSERT INTO Locations_2 VALUES("Summer", "Sunshine");
INSERT INTO Locations_2 VALUES("Winter", "Snow");
INSERT INTO Locations_2 VALUES("Autumn", "Fog");
INSERT INTO Locations_2 VALUES("Spring", "Rain");
```

```sql
INSERT INTO RaceTracks VALUES("Nürburgring", "Hill Climb", "Germany");
INSERT INTO RaceTracks VALUES("Suzuka Circuit", "Permanent Circuit",
"Germany");
INSERT INTO RaceTracks VALUES("Indianapolis Motor", "Speedway", "United
States");
INSERT INTO RaceTracks VALUES("Sau Paulo", "Street Circuit", "Germany");
INSERT INTO RaceTracks VALUES("Ultra4 UK", "Off Road", "United Kingdom");
INSERT INTO RaceTracks VALUES("Laguna Seca", "Permanent Circuit", "United
States");

INSERT INTO PowerUps_1 VALUES("Banana", "Causes the user's car to spin
out.", 3, "Common");
INSERT INTO PowerUps_1 VALUES("Green Shell", "Can be launched by a
character to spin out an opponent car.", 5, "Rare");
INSERT INTO PowerUps_1 VALUES("EMP", "Causes the user's car to turn off",
3, "Common");
INSERT INTO PowerUps_1 VALUES("Nitrous Oxide", "Temporarily increases car
acceleration by 30", 10, "Rare");
INSERT INTO PowerUps_1 VALUES("Ghost", "Makes the car invisible to other
cars", 1, "Very Rare");
INSERT INTO PowerUps_1 VALUES("Lightning", "Causes all opponents to lose
their power-ups", 1, "Very Rare");
INSERT INTO PowerUps_1 VALUES("Jerrycan", "Temporarily increases car speed
by 10", 5, "Common");
INSERT INTO PowerUps_1 VALUES("Steering wheel", "Temporarily increases car
handling by 20", 7, "Common");

INSERT INTO PowerUps_2 VALUES("Causes the user's car to spin out.",
"Offensive");
INSERT INTO PowerUps_2 VALUES("Can be launched by a character to spin out
an opponent car.", "Offensive");
INSERT INTO PowerUps_2 VALUES("Causes the user's car to turn off",
"Offensive");
INSERT INTO PowerUps_2 VALUES("Temporarily increases car acceleration by
30", "Status");
INSERT INTO PowerUps_2 VALUES("Makes the car invisible to other cars",
"Defensive");
INSERT INTO PowerUps_2 VALUES("Causes all opponents to lose their
power-ups", "Offensive");
INSERT INTO PowerUps_2 VALUES("Temporarily increases car speed by 10",
"Status");
INSERT INTO PowerUps_2 VALUES("Temporarily increases car handling by 20",
"Status");
```

```sql
INSERT INTO Tournaments VALUES("American Cup", "Diamond Eagle Statue");
INSERT INTO Tournaments VALUES("Drift Championship", "Gold Medal");
INSERT INTO Tournaments VALUES("European Cup", "Gold Cup");
INSERT INTO Tournaments VALUES("Pan-American Championship", "Gold Plaque");
INSERT INTO Tournaments VALUES("World Championship", "Diamond Globe
Statue");

INSERT INTO SpecialAbilties VALUES( "Focus", "Makes the character immune
from negative power-ups from opponents", "Aloy");
INSERT INTO SpecialAbilties VALUES("Finishing Touch", "Can be activated
once in a race to decrease the speed of all opponent cars by 50 for 20s",
"Cloud Strife");
INSERT INTO SpecialAbilties VALUES("Speed Shoes", "Permanently increases
car speed by 15", "Crash Bandicoot");
INSERT INTO SpecialAbilties VALUES("Duration Boost", "Permanently doubles
the duration of all consumed power-ups", "Isabelle");
INSERT INTO SpecialAbilties VALUES("Fire Flower", "Can be activated up to 3
times in a race to spin out opponent cars", "Mario");
INSERT INTO SpecialAbilties VALUES("Fortune Pill", "50% chance of
increasing car speed by 10", "Mario");
INSERT INTO SpecialAbilties VALUES("Spartan Sprint", "Permanently increases
car speed by 20", "Master Chief");
INSERT INTO SpecialAbilties VALUES("Magic", "Permanently increases all car
stats by 5", "Princess Zelda");
INSERT INTO SpecialAbilties VALUES("Cardboard box", "Can be activated up to
3 to make the character's car invisible from other characters for 10s",
"Solid Snake");
INSERT INTO SpecialAbilties VALUES("Spin Dash", "Permanently increases car
speed and acceleration by 10", "Sonic the Hedgehog");

INSERT INTO CharactersParticipateInRaces VALUES("Aloy", "Circuit 1");
INSERT INTO CharactersParticipateInRaces VALUES("Mario", "Circuit 1");
INSERT INTO CharactersParticipateInRaces VALUES("Sonic the Hedgehog",
"Circuit 3");
INSERT INTO CharactersParticipateInRaces VALUES("Cloud Strife", "Circuit
4");
INSERT INTO CharactersParticipateInRaces VALUES("Isabelle", "Circuit 5");
INSERT INTO CharactersParticipateInRaces VALUES("Master Chief", "Time Trial
1");
INSERT INTO CharactersParticipateInRaces VALUES("Solid Snake", "Time Trial
2");
INSERT INTO CharactersParticipateInRaces VALUES("Princess Zelda", "Time
```

```
Trial 3");
INSERT INTO CharactersParticipateInRaces VALUES("Crash Bandicoot", "Time
Trial 4");
INSERT INTO CharactersParticipateInRaces VALUES("Mario", "Time Trial 5");
INSERT INTO CharactersParticipateInRaces VALUES("Aloy", "Time Trial 2");

INSERT INTO CharactersParticipateInTournaments VALUES("Mario", "American
Cup");
INSERT INTO CharactersParticipateInTournaments VALUES("Mario", "World
Championship");
INSERT INTO CharactersParticipateInTournaments VALUES("Princess Zelda",
"American Cup");
INSERT INTO CharactersParticipateInTournaments VALUES("Crash Bandicoot",
"Drift Championship");
INSERT INTO CharactersParticipateInTournaments VALUES("Isabelle", "European
Cup");
INSERT INTO CharactersParticipateInTournaments VALUES("Aloy", "Pan-American
Championship");
INSERT INTO CharactersParticipateInTournaments VALUES("Aloy", "American
Cup");
INSERT INTO CharactersParticipateInTournaments VALUES("Sonic the Hedgehog",
"World Championship");

INSERT INTO TournamentsIncludeRaces VALUES("American Cup", "Circuit 3");
INSERT INTO TournamentsIncludeRaces VALUES("American Cup", "Time Trial 3");
INSERT INTO TournamentsIncludeRaces VALUES("Drift Championship", "Circuit
2");
INSERT INTO TournamentsIncludeRaces VALUES("European Cup", "Circuit 5");
INSERT INTO TournamentsIncludeRaces VALUES("Pan-American Championship",
"Circuit 4");
INSERT INTO TournamentsIncludeRaces VALUES("World Championship", "Circuit
1");
INSERT INTO TournamentsIncludeRaces VALUES("World Championship", "Circuit
2");

INSERT INTO RaceTracksHostRaces VALUES("Nürburgring", "Circuit 1");
INSERT INTO RaceTracksHostRaces VALUES("Suzuka Circuit", "Circuit 2");
INSERT INTO RaceTracksHostRaces VALUES("Indianapolis Motor", "Circuit 3");
INSERT INTO RaceTracksHostRaces VALUES("Sau Paulo", "Circuit 4");
INSERT INTO RaceTracksHostRaces VALUES("Ultra4 UK", "Circuit 5");
INSERT INTO RaceTracksHostRaces VALUES("Laguna Seca", "Time Trial 1");
INSERT INTO RaceTracksHostRaces VALUES("Nürburgring", "Time Trial 2");
INSERT INTO RaceTracksHostRaces VALUES("Suzuka Circuit", "Time Trial 3");
```

```sql
INSERT INTO RaceTracksHostRaces VALUES("Sau Paulo", "Time Trial 4");
INSERT INTO RaceTracksHostRaces VALUES("Ultra4 UK", "Time Trial 5");

INSERT INTO RacesHavePowerUps VALUES("Circuit 1", "Banana");
INSERT INTO RacesHavePowerUps VALUES("Circuit 2", "Banana");
INSERT INTO RacesHavePowerUps VALUES("Circuit 1", "Green shell");
INSERT INTO RacesHavePowerUps VALUES("Time Trial 4", "EMP");
INSERT INTO RacesHavePowerUps VALUES("Time Trial 5", "Steering wheel");
```