

プログラミング概論

第10回 2024年11月27日

App Inventorによる

Androidアプリ開発の実践

(4) 物理シミュレーション1

今回の授業内容

- コンピュータシミュレーションとは
- コンピュータの画面上で「動き」を表現するには
- 等速直線運動
- 的当てゲームを作る

コンピュータシミュレーション とは

コンピュータシミュレーション

自然や社会に見られる現象をコンピュータ上で模擬的に再現すること → 分析や予測, ゲームに有用

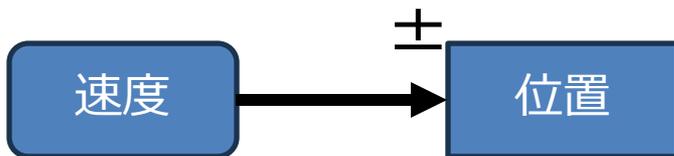
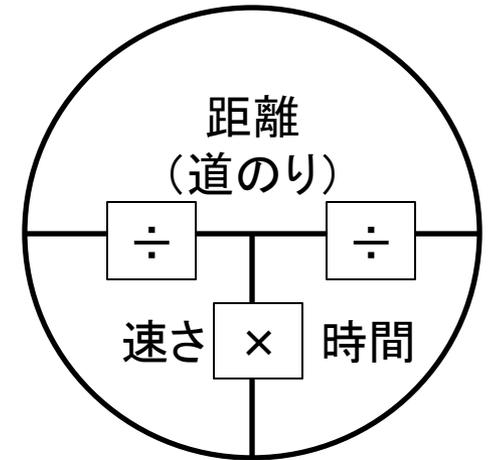
コンピュータ上で模擬するためには必要なこと

- ・現象の本質をとらえ, そのしくみを単純化
- ・ルールや数式により記述

第10回～第12回の授業では
物理現象のひとつである力学のうちの
「物体の運動」に焦点を当て, コンピュータ上で
模擬する方法の基礎を学ぶ

“動き”のシミュレーション

- 一回あたりの移動量 = 速度
- 毎回速度 × 時間を位置に加えればよい



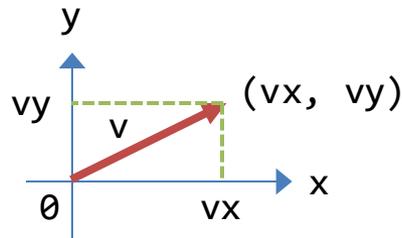
$$x' = x + v_x \times \Delta t$$

(元の x に速度 \times 時間を足したものが次の x)

$$y' = y + v_y \times \Delta t$$

(元の y に速度 \times 時間を足したものが次の y)

コンピュータの画面上で 「動き」を表現するには



1秒間に動く量

t秒後の位置は？

$$x(t) = x(0) + v_x \times t$$

$$y(t) = y(0) + v_y \times t$$

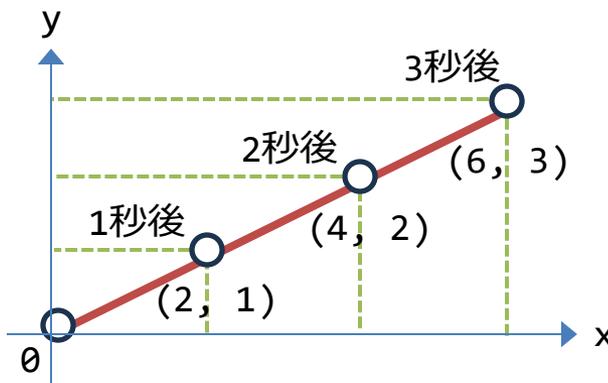
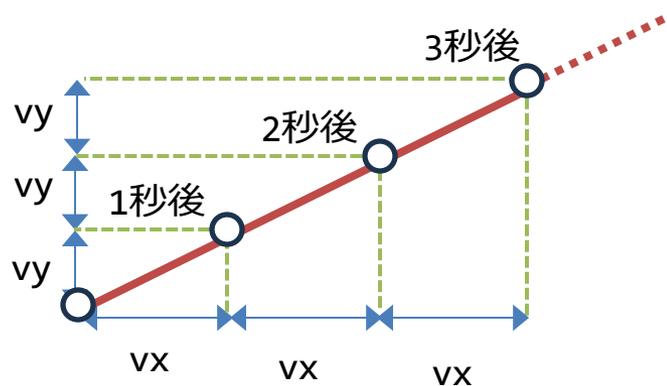
↓

速度が一定でないとダメ

↓

$$x_{(t+1)} = x(t) + v_{x(t)}$$

$$y_{(t+1)} = y(t) + v_{y(t)}$$



$$x_{(4)} = 0 + 2 \times 4 = 8$$

$$y_{(4)} = 0 + 1 \times 4 = 4$$

いまの時刻tから**1秒後**の位置を求める.

$x(t)$ と $y(t)$ はいまの位置,

$v_x(t)$ と $v_y(t)$ は1秒間に動く量を表している.

等速直線運動

表示される値をそれぞれ考えてみよう

```
set x to 0
set vx to 1
repeat 5 times
do
  set x to x + vx
  print x
```

```
set x to 0
set vx to 2
repeat 5 times
do
  set x to x + vx
  print x
```

```
set x to 0
set vx to -1
repeat 5 times
do
  set x to x + vx
  print x
```

/ / / /

/ / / /

/ / / /

v_x (移動量) は繰り返しの間, 常に一定



等速直線運動

考えたら [Blockly Code](#) で確かめよう



的当てゲームを作る



新しいプロジェクトをつくる

MIT APP INVENTOR

Projects Connect Build Settings Help My Projects View Trash Guide Report an Issue English akiyolab5@gmail.com

New project New Folder Move... Move To Trash View Trash Login to Gallery Publish to Gallery

Name	Date Created	Date Modified
<input type="checkbox"/> Taiko	Nov 14, 2023, 1:39:06 PM	Nov 14, 2023, 2:01:17 PM
<input type="checkbox"/> Gakki	Nov 7, 2023, 11:23:20 PM	Nov 14, 2023, 1:16:02 PM
<input type="checkbox"/> Kazuate	2023, 11:43:06 AM	Nov 1, 2023, 11:50:14 AM
<input type="checkbox"/> Omikuji	2023, 1:08:14 PM	Nov 1, 2023, 11:07:51 AM

今回は「Matoate」

Create new App Inventor project

Project name: Matoate

Toolkit: Default

Theme: Device Default

Cancel

Classic
Device Default
Black Title Text
Dark

Classic を選択する
(前回Classicにしていれば Device Defaultでもよいはず)

Privacy Policy and Terms of Use

アプリのタイトルを変える

The screenshot shows the MIT App Inventor web interface. At the top, there is a navigation bar with the MIT App Inventor logo and various menu items like Projects, Connect, Build, Settings, Help, My Projects, View Trash, Guide, Report an Issue, English, and a user profile. Below the navigation bar is a left sidebar with a list of components: Spinner, Switch, TextBox, TimePicker, and WebViewer. The main workspace is divided into three sections: a central canvas showing a mobile app preview, a top-right section with 'Rename' and 'Delete' buttons, and a bottom-right section with an 'Upload File ...' button. On the right side, there is a properties panel for the selected component. The 'Title' property is highlighted with a red box and contains the text '的当てゲーム'. A blue arrow points from the text '今回は自由に変更OK' to the 'Title' property field. The bottom of the page has a 'Privacy Policy and Terms of Use' link.

MIT APP INVENTOR

Projects Connect Build Settings Help My Projects View Trash Guide Report an Issue English akiyolab5@gmail.com

Spinner Switch TextBox TimePicker WebViewer

Layout Media Drawing and Animation Maps Charts Data Science Sensors Social Storage Connectivity LEGO® MINDSTORMS® Experimental

CloseScreenAnimation Default HighContrast OpenScreenAnimation Default PrimaryColor Default PrimaryColorDark Default ScreenOrientation Unspecified Scrollable ShowListsAsJson ShowStatusBar Title 的当てゲーム TitleVisible Application

Rename Delete

Media Upload File ...

今回は自由に変更OK ---->

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VerticalArrangementを配置する

The screenshot shows the MIT App Inventor web interface. The top navigation bar includes the MIT App Inventor logo and various menu items like Projects, Connect, Build, Settings, Help, My Projects, View Trash, Guide, Report an Issue, English, and a user email. The main workspace is divided into four panels: Palette, Viewer, All Components, and Properties.

- Palette:** The 'Layout' section is expanded, and 'VerticalArrangement' is selected. A red arrow points from this component to the Viewer.
- Viewer:** A mobile phone simulator is shown with 'Screen1' on the screen. A checkbox 'Display hidden components in Viewer' is checked. The phone size is set to 'Phone size (320 x 505)'.
- All Components:** A list shows 'Screen1' as the active component.
- Properties:** The 'Appearance' section is expanded. The 'Height' property is set to '320 pixels...' and the 'Width' property is set to 'Fill parent...'. A red box highlights these two properties. Blue arrows point from the text '“320” pixels' to the Height field and '“Fill parent”' to the Width field.

At the bottom of the interface, there are 'Rename' and 'Delete' buttons for the selected component.

[Privacy Policy and Terms of Use](#)

キャンバスを配置する

The screenshot displays the MIT App Inventor web interface. At the top, a blue banner contains the title "キャンバスを配置する". Below the banner is the browser address bar showing the URL "ai2.appinventor.mit.edu/#4783042956492800". The main interface is divided into several panels:

- Palette:** A sidebar on the left with a search bar and categories like "User Interface", "Layout", "Media", "Drawing and Animation", "Maps", "Charts", "Data Science", "Sensors", "Social", "Storage", and "Connectivity". The "Canvas" component is highlighted in green in the "Drawing and Animation" section. A red arrow points from this "Canvas" component to the viewer.
- Viewer:** A central area showing a mobile phone screen labeled "Screen1". A "Canvas" component is being placed on the screen, indicated by a red arrow from the palette. Above the viewer, there are options to "Display hidden components in Viewer" and a dropdown menu set to "Phone size (320 x 505)".
- All Components:** A panel on the right showing a tree view of the project's components: "Screen1", "VerticalArrangement1", and "Canvas1".
- Properties:** A panel on the far right showing the properties for the selected "Canvas1 (Canvas)" component. The "Appearance" section is expanded, showing properties like "BackgroundColor", "BackgroundImage", "FontSize", "Height", "Width", "LineWidth", "PaintColor", "TextAlignment", and "Visible".

At the bottom of the interface, there are "Rename" and "Delete" buttons for the selected component, and a "Privacy Policy and Terms of Use" link.

背景を設定する

The screenshot displays the MIT App Inventor web interface. At the top, a blue banner contains the title "背景を設定する". Below it, the browser address bar shows the URL "ai2.appinventor.mit.edu/#4783042956492800". The interface is divided into several panels: "Palette" on the left with categories like "User Interface", "Layout", "Media", "Drawing and Animation", "Maps", "Charts", "Data Science", "Sensors", "Social", "Storage", and "Connectivity"; "Viewer" in the center showing a mobile phone simulation with a "Canvas" component highlighted; "Components" on the right showing a tree view with "Screen1", "VerticalArrangement1", and "Canvas1"; and "Properties" on the far right. The "Properties" panel for "Canvas1 (Canvas)" has two red boxes highlighting the "Appearance" section (containing "BackgroundColor" set to "Light Gray") and the "Size" section (containing "Height" set to "320 pixels..." and "Width" set to "Fill parent..."). Blue arrows point from the text "Light Gray" and "320 pixels" to their respective values in the interface. The "Width" property is labeled "Fill parent". At the bottom of the interface, there are "Rename" and "Delete" buttons, and a footer link for "Privacy Policy and Terms of Use".

Search Components...

User Interface

Layout

Media

Drawing and Animation

Ball

Canvas

ImageSprite

Maps

Charts

Data Science

Sensors

Social

Storage

Connectivity

LEGO® MINDSTORMS®

Projects

Connect

Build

Settings

Help

My Projects

View Trash

Guide

Report an Issue

English

akiyolab5@gmail.com

Display hidden components in Viewer

Phone size (505,320)

Screen1

VerticalArrangement1

Canvas1

Canvas1 (Canvas)

Appearance

BackgroundColor

Light Gray

BackgroundImage

None...

FontSize

14.0

Height

320 pixels...

Width

Fill parent...

LineWidth

2.0

PaintColor

Default

TextAlignment

center : 1

Visible

Rename

Delete

Privacy Policy and Terms of Use

球をつくる

The screenshot displays the MIT App Inventor web interface. At the top, a blue banner contains the text "球をつくる". Below it, the browser address bar shows the URL "ai2.appinventor.mit.edu/#4783042956492800". The MIT App Inventor logo and navigation menu are visible at the top left. The left sidebar lists various components, with "Drawing and Animation" expanded to show "Ball", "Canvas", and "ImageSprite". A red arrow points from the "Ball" component to a small black square on the mobile device preview's canvas. The mobile device screen shows a game titled "的当てゲーム" with a small black square on the canvas. The right sidebar shows the properties for the "Ball1" object. The "X" and "Y" coordinates are both set to 50, and the "Interval" is set to 50. These three settings are highlighted with red boxes. Blue arrows point to the "50" values in the X, Y, and Interval fields. The "Behavior" section is also visible, with "Enabled" checked and "Interval" set to 50. The "OriginAtCenter" checkbox is also checked. At the bottom, there are "Rename" and "Delete" buttons, and a "Media" section with a "50" value and a "チェック" (Check) button.

[Privacy Policy and Terms of Use](#)

的をつくる

ai2.appinventor.mit.edu/#4783042956492800

MIT APP INVENTOR

Projects Connect Build Settings Help My Projects View Trash Guide Report an Issue English akiyolab5@gmail.com

Layout
Media
Drawing and Animation
Ball
Canvas
ImageSprite
Maps
Charts
Data Science
Sensors
Social
Storage
Connectivity
LEGO® MINDSTORMS®
Experimental
Extension

Ball1
Ball2 Red →
25 →
270 →
270 →

PaintColor[?]
Red
Radius[?]
25
Visible[?]

X[?]
270
Y[?]
270
Z[?]
1.0
▼ Behavior
Enabled[?]

Heading[?]
0
Interval[?]
100
OriginAtCenter[?]

Rename Delete

Upload File →

Privacy Policy and Terms of Use

ボタンなどを配置するためのレイアウト

The screenshot displays the MIT App Inventor web interface. At the top, a navigation bar includes 'Projects', 'Connect', 'Build', 'Settings', 'Help', 'My Projects', 'View Trash', 'Guide', 'Report an Issue', 'English', and the user email 'akiyolab5@gmail.com'. The main workspace is divided into three sections: a left sidebar, a central canvas, and a right-hand properties panel.

The left sidebar contains several categories: 'Layout', 'Media', 'Drawing and Animation', 'Maps', 'Charts', 'Data Science', 'Sensors', 'Social', 'Storage', 'Connectivity', and 'LEGO® MINDSTORMS®'. Under the 'Layout' category, 'HorizontalArrangement' is selected and highlighted in green. A red arrow points from the 'Projects' menu to this selection. Another red arrow points from the 'HorizontalArrangement' selection to a corresponding widget on the canvas.

The central canvas shows a mobile phone interface with the title '的当てゲーム' (Target Game). It features a black dot in the upper left and a large red circle in the lower right. A grey rectangular widget is positioned at the bottom of the screen, which is the 'HorizontalArrangement' widget selected in the sidebar.

The right-hand properties panel is titled 'Appearance' and shows settings for the selected widget: 'AlignHorizontal' (Left: 1), 'AlignVertical' (Top: 1), 'BackgroundColor' (Default), 'Height' (Automatic...), 'Width' (Automatic...), 'Image' (None...), and 'Visible' (checked). Below the panel are 'Rename' and 'Delete' buttons. At the bottom of the interface, there is a 'Media' section with an 'Upload File ...' button.

At the bottom of the page, there is a link for 'Privacy Policy and Terms of Use'.

リセットボタンをつくる

The screenshot shows the MIT App Inventor web interface. At the top, a blue banner contains the title "リセットボタンをつくる". Below it, the browser address bar shows the URL "ai2.appinventor.mit.edu/#4783042956492800". The main interface is divided into several sections:

- User Interface:** A list of UI components on the left. A red arrow points from the "Button" component to a "Reset" button placed on a mobile device preview in the center. The mobile preview shows a game titled "的当てゲーム" (Target Game) with a red circle on the screen.
- Properties Panel:** On the right, the properties for the selected "Button1" component are shown. The "Text" property is highlighted with a red box and contains the text "Reset". A blue arrow labeled "Reset" points from the mobile preview to this text field.
- Media Panel:** Below the properties panel, there is a "Media" section with an "Upload File ..." button.

At the bottom of the interface, there is a link for "Privacy Policy and Terms of Use".

当たった回数/試行回数と座標表示部分

MIT APP INVENTOR

Projects Connect Build Settings Help My Projects View Trash Guide Report an Issue English akiyolab5@gmail.com

User Interface

- Button
- CheckBox
- DatePicker
- Image
- Label**
- ListPicker
- ListView
- Notifier
- PasswordTextBox
- Slider
- Spinner
- Switch
- TextBox
- TimePicker
- WebView

Phone size (505,320)

Canvas1

- Ball1
- Ball2
- HorizontalArrangement1
- Button1
- Label1
- Label2
- Label3**

Appearance

BackgroundColor

FontBold

FontItalic

FontSize

FontTypeface

HTMLFormat

HasMargins

Height

Width

Text

0/0 x y

Reset

Label1は0/0
Label2はx
Label3はyにする

※ Resetと同じレイアウトに入れる

一定の間隔で繰り返す処理をつくる

The screenshot displays the MIT App Inventor web interface. At the top, a blue banner contains the title "一定の間隔で繰り返す処理をつくる". Below it, the browser address bar shows the URL "ai2.appinventor.mit.edu/#4783042956492800". The interface includes a navigation menu with options like "Projects", "Connect", "Build", "Settings", "Help", "My Projects", "View Trash", "Guide", "Report an Issue", "English", and "akiyolab5@gmail.com".

On the left, the "Sensors" category is selected, and the "Clock" component is highlighted. A red arrow points from the "Clock" component in the "Sensors" list to a red circle on the mobile app preview. Another red arrow points from the "Data Science" category to the "Sensors" category. A third red arrow points from the "Clock" component in the "Sensors" list to the "TimerInterval" property in the "Properties" panel.

The "Properties" panel on the right shows the "TimerInterval" property set to "50". A red box highlights this property, and a blue arrow points from the "50" value to the "TimerInterval" property name. Below the "Properties" panel, the "Media" section is visible with an "Upload File ..." button.

At the bottom of the interface, there is a "Non-visible components" section and a "Privacy Policy and Terms of Use" link.

ここまでできたらBlocksへ

The screenshot displays the MIT App Inventor web interface. At the top, a blue banner contains the text "ここまでできたらBlocksへ". Below this is the browser address bar showing the URL "ai2.appinventor.mit.edu/#4783042956492800". The interface includes a navigation menu with options like "Projects", "Connect", "Build", "Settings", "Help", "My Projects", "View Trash", "Guide", "Report an Issue", "English", and a user profile "e1310913@g.tohoku-gakuin.ac.jp". A red arrow points to the user profile icon in the top right corner.

The main workspace is divided into several panels:

- Palette:** A sidebar on the left with a search bar and categories: "User Interface", "Layout", "Media", "Drawing and Animation", "Maps", "Charts", "Data Science", and "Sensors". The "Clock" component is highlighted in the "Sensors" category.
- Viewer:** A central area showing a mobile phone simulation. It includes a checkbox for "Display hidden components in Viewer" and a dropdown for "Phone size (320 x 505)". The phone screen displays the text "的当てゲーム" and a red circle at the bottom right.
- All Components:** A panel on the right showing a tree view of the app's components: "Screen1" (containing "Canvas1" with "Ball1" and "Ball2"), "HorizontalArrangement1" (containing "Button1", "Label1", "Label2", and "Label3"), and "Clock1".
- Properties:** A panel on the far right showing the properties for the selected "Clock1 (Clock)" component. Under the "Behavior" section, "TimerAlwaysFires" and "TimerEnabled" are checked, and "TimerInterval" is set to "50".

アプリ起動時の初期化とリセット処理

(Built-in) Variables initialize global vx to 0 Clock1.Timerが1回実行されるごとのX軸方向の移動量

initialize global vy to 0 Clock1.Timerが1回実行されるごとのY軸方向の移動量

(Screen1) when Screen1 Initialize (Screen1) アプリが起動したら (初期化)
do
 set Canvas1 . Width to Screen1 . Width
 set Canvas1 . Height to Screen1 . Width
 set Ball2 . X to Canvas1 . Width - 50
 set Ball2 . Y to Canvas1 . Width - 50
 キャンバスの幅を画面の幅に
 キャンバスの高さも (正方形)
 的のx座標は右下から50ずらす
 的のy座標も同様に

(Button1) when Button1 .Click
do
 set global vx to 0
 set global vy to 0
 set Ball1 . X to 50
 set Ball1 . Y to 50
 set Ball1 . Visible to true
 リセットボタンが押されたら
 球は動かないようにする
 球のx座標・y座標は初期位置に戻す
 球は見えるようにする

(Ball1) when Ball1 .EdgeReached
edge
do
 set Ball1 . Visible to false
 球が画面端に当たったときには
 見えなくする

※ Canvas1とかついているBlockはそれぞれのcomponentの場所にある

球を飛ばす処理

when Clock1 .Timer

```
do
  set Ball1 . X to [Ball1 . X] + [get global vx]
  set Ball1 . Y to [Ball1 . Y] + [get global vy]
  set Label2 . Text to [Ball1 . X]
  set Label3 . Text to [Ball1 . Y]
```

50ミリ秒に1回行われる処理

球を移動する

球の座標を画面に表示する

$$x' = x + v_x \times \Delta t$$

$$y' = y + v_y \times \Delta t$$

($\Delta t=1$ と考える)

when Canvas1 .Dragged

```
startX  startY  prevX  prevY  currentX  currentY  draggedAnySprite
do
  call Canvas1 .Clear
  call Canvas1 .DrawLine
    x1 [50]
    y1 [50]
    x2 [get currentX]
    y2 [get currentY]
```

クリック
↓
ドラッグ

ドラッグしたとき

球の初期位置から現在地まで
直線を描く

when Canvas1 .TouchUp

```
x  y
do
  call Canvas1 .Clear
  set global vx to [0.2] × [Ball1 . X] - [get x]
  set global vy to [0.2] × [Ball1 . Y] - [get y]
```

ドラッグした手を離れたとき

直線を消す

球の移動量を設定する

(手を離れた位置が球の位置より
離れている方が大きな値に)

ここまでできたら動作確認すること

当たった回数と試行回数の表示処理

initialize global score to 0

initialize global total to 0

```
when Button1 .Click
do
  set global vx to 0
  set global vy to 0
  set Ball1 . X to 50
  set Ball1 . Y to 50
  set Ball1 . Visible to true
  set global total to (get global total + 1)
  set Label1 . Text to (join (get global score) "/" (get global total))
```

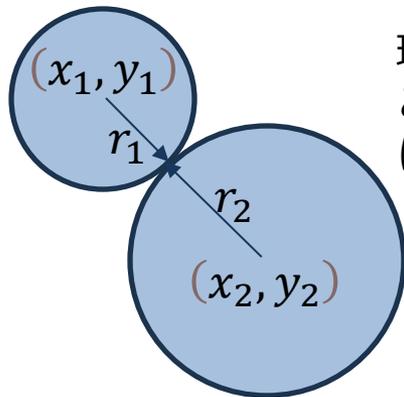
(元からあるブロックに)
追加

ここまでで再び動作確認すること

衝突したら球が跳ね返るようにする

```
when Clock1.Timer
do
  set Ball1.X to Ball1.X + get global vx
  set Ball1.Y to Ball1.Y + get global vy
  if square root < 30
  then
    set global vx to
    set global vy to
    set global score to get global score + 1
  set Label2.Text to Ball1.X
  set Label3.Text to Ball1.Y
```

追加

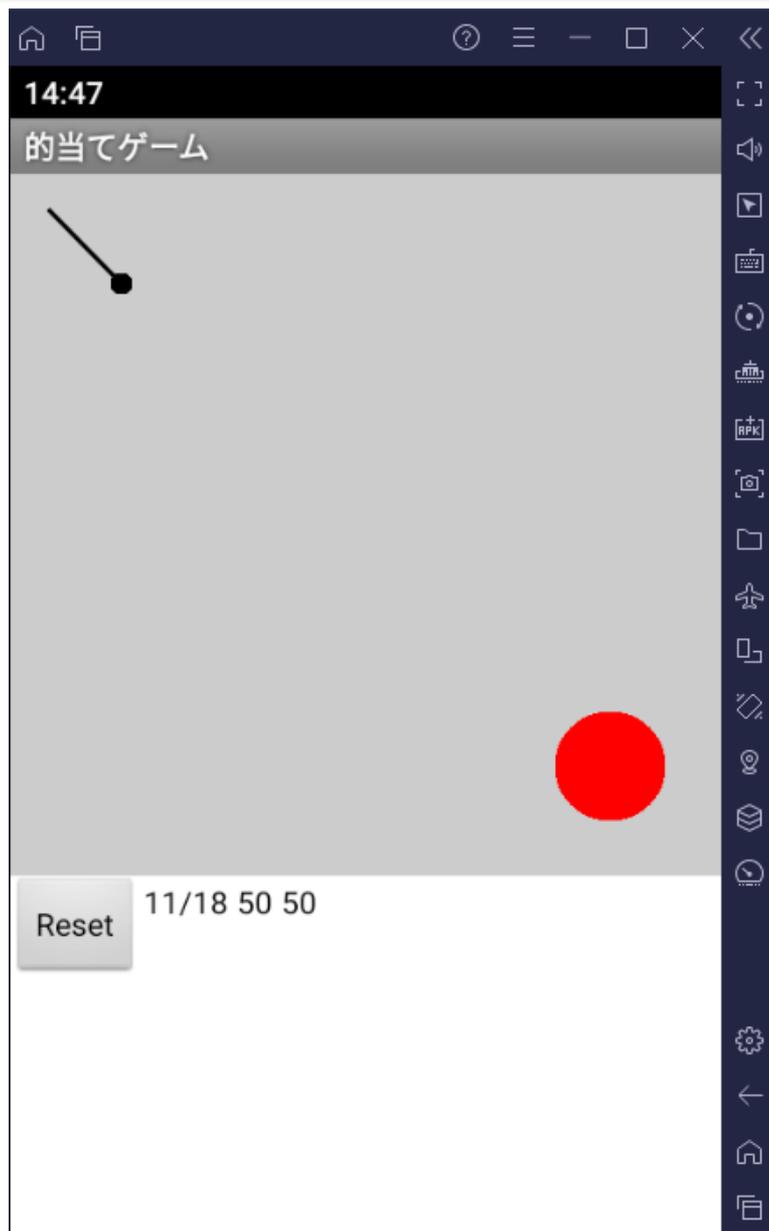


球と的の半径を r_1 と r_2 とし、中心の座標をそれぞれ (x_1, y_1) と (x_2, y_2) とする。このとき (x_1, y_1) と (x_2, y_2) の距離が $r_1 + r_2$ より小さければ重なっていることになり「衝突している状態」と言える。

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} < r_1 + r_2$$

衝突処理を追加したら動作確認

実行画面



工夫してみよう

- Resetするたびに的のx座標が変わるようにしてみよう
- Resetするたびに的の大きさが変わるようにしてみよう
- 的が常に移動するようにしてみよう