Course Project: ...

> Calculator mimics a real-world calculator.

1. Data structure

- This application does not have a data structure for simplicity.

2. Service functions

- calculateExpression
- _formatResult
- _is functions
- _get functions
- pressedButton

calculateExpression

- Instead of parsing a user expression using a lexer and a parser, we use an existing library.
- We need to add the math_expression package to the dependencies

```
dependencies:
  ...
  math_expressions: ^2.3.0
```

- We import the library before we use the functions.

```
import 'package:math_expressions/math_expressions.dart';

void calculateExpression() {
    ExpressionParser parser = GrammarParser();
    Expression expression = parser.parse(userQuestion);
    var context = ContextModel();
    double result = expression.evaluate(EvaluationType.REAL, context);
}
```

- We need to redraw the GUI and use setState to trigger the build functions.

```
setState(() {
 userAnswer = _formatResult(result);
});
```

_formatResult

- After the arithmetic computation, the results can be lengthy or end with a dot.

```
"5.000000" → "5."
"3.140000" → "3.14"
"5." → "5"
"10." → "10"
```

- The _formatResult function uses a regular expression to format the result.

```
String _formatResult(num result) {
  if (result == result.toInt()) {
    return result.toInt().toString();
  } else {
    return result
        .toStringAsFixed(6)
        .replaceAll(RegExp(r'0*$'), '')
        .replaceAll(RegExp(r'\.$'), '');
  }
}
```

_is functions

- We can check if a certain button is an operator or a specific key.

```
bool _isOperator(String button) {
  return ['+', '-', '*', '/', '%'].contains(button);
}

bool _isSpecial(String button) {
  return ['C', 'DEL', '=', 'ANS'].contains(button);
}
```

_get functions

- Based on the _is functions, we can choose the color.
- _getButtonColor function returns the color for each operator.

```
Color _getButtonColor(String button) {
  if (button == '=') {
    return Colors.deepPurple[400]!;
  } else if (_isOperator(button)) {
    return Colors.deepPurple[300]!;
...
}
```

- We can get text color likewise.

```
Color _getTextColor(String button) {
  if (button == '=' || _isOperator(button)) {
    return Colors.white;
  } else {
    return Colors.black;
  }
}
```

pressedButton

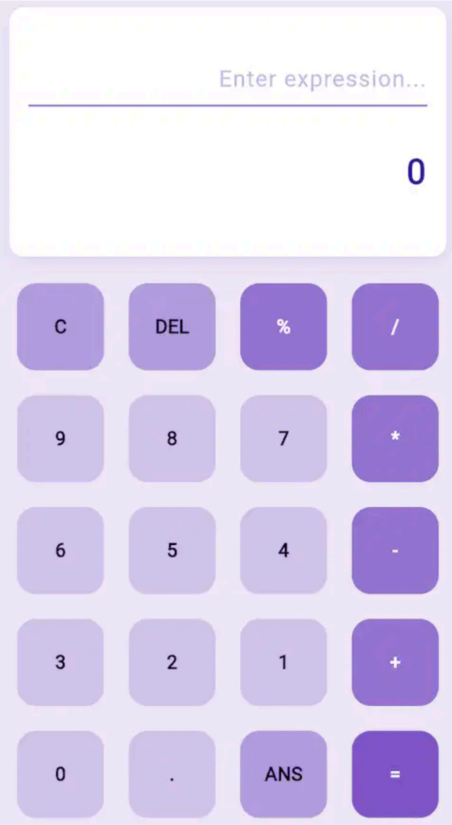
- This function interprets the button to display numbers or compute.
- It uses the setState function to redraw widgets.

```
void pressedButton(String button) {
  setState(() {
    if (button == 'C') { ...
    } else if (button == 'DEL') { ...
    } else if (button == '=') {
      calculateExpression();
    } else if (button == 'ANS') {
      userQuestion += userAnswer;
    } else {
      userQuestion += button;
    }
  });
}
```

3. User interface

- main.dart
- MyButton (button.dart)

main.dart



- It has the classic Flutter program structure.

```
void main() => runApp(const MyApp());
class MyApp extends StatelessWidget {
  Widget build(BuildContext context) {
    return const MaterialApp(home: HomePage(),);
  }
}
class HomePage extends StatefulWidget {
  State<HomePage> createState() => _HomePageState();
}
class _HomePageState extends State<HomePage> {...}
```

Widget structure

- It is a column structure with two sections: display and button.

```
return Scaffold(
  body: Column(
    children: [
      // Display Section
      Expanded(...)
      // Buttons Section
      Expanded(...)
    ]
  )
```

Display section

- The display section has a column structure with two texts for user expression and output display.

```
child: Container(
  child: Column(
    children: [
      // Show expression
      Container(child: Text(...),),
      // Output Section
      Container(child: Text(...),),
    ],
  ),
),
```

Button section

- It uses GridView.builder to generate 4-column buttons.

```
child: Container(
  child: GridView.builder(
    itemBuilder: (context, index) {
      return MyButton( ... );
    },
  ),
```

- In the itemBuilder, it gets the button, color, and action when pressed.

```
itemBuilder: (context, index) {
  return MyButton(
    child: buttons[index],
    buttonColor: _getButtonColor(buttons[index]),
    textColor: _getTextColor(buttons[index]),
    function: () {
      pressedButton(buttons[index]);
    },
  );
```

- The calculator prevents scrolling with NeverScrollableScrollPhysics.
- With SliverGridDelegateWithFixedCrossAxisCount, the four-width column is set.

```
physics: const NeverScrollableScrollPhysics(),
gridDelegate: const SliverGridDelegateWithFixedCrossAxisCount(
  crossAxisCount: 4,
  ...
),
```

MyButton (button.dart)

Widget Structure

- We need a rounded rectangular button.

```
child: ClipRRect(
  borderRadius: BorderRadius.circular(20),
  child: Container(
      height: 100, width: 100,
      color: buttonColor,
      child: Center(child: Text(...)),
),
```

ClipRRect widget

- ClipRRect is a Flutter widget that clips its child using rounded rectangles.
- It creates a rounded rectangular clipping area for its child widget, making corners rounded and hiding any content that extends beyond those boundaries

4. Program structure

- This application does not use any software architecture.
- The code is simple but looks complicated due to the decorations.

```
.
├── button.dart
└── main.dart
```

Self-grading for HW

- You analyze the whole code once (30%).
- You analyze the whole code twice using a different method (60%).
  - Make a summary of widgets that you did not know before (what and how to use them).
- You understand how the code works (80%).
- You can use the programming techniques in this example to make team and individual projects (100%).