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Numerical Analysis Homework 2b

Kincaid 3.3 #8) Program the Newton algorithm in complex arithmetic, and test it on these functions with the given starting points.

```
NewtonIteration[F_, a_] := a - F[a]/F'[a] ;

RunProgram[F_, a_, iter_] :=
  Block[{x = a, i = 0},
   For[i = 0, i <= iter, i++,
    Print[StringExpression["Iteration "], i,
     StringExpression[": "], N[x]];
    x = NewtonIteration[F, x]]];
```

(a)

```
f[z_] := z^2 - 1;
RunProgram[f, 3 + i, 5]

Iteration 0: 3. + 1. i

Iteration 1: 1.65 + 0.45 i

Iteration 2: 1.10705 + 0.148077 i

Iteration 3: 0.997237 + 0.0146885 i

Iteration 4: 0.999895 - 0.0000391458 i

Iteration 5: 1. + 4.10798 × 10^-9 i
```

(b)

```
In[95]:= f[z_] := z + Sin[z] - 3;
         RunProgram[f, 2 - i, 5]

         Iteration 0: 2. - 1. i

         Iteration 1: 2.31634 - 0.516828 i

         Iteration 2: 2.43554 - 0.0665797 i

         Iteration 3: 2.09744 + 0.0618869 i

         Iteration 4: 2.17654 + 0.00845053 i

         Iteration 5: 2.17981 + 0.0000525506 i
```

(c)

```
In[97]:= f[z_] := z^4 + z^2 + 2 + 3 i;
         RunProgram[f, 1, 5]

         Iteration 0: 1.

         Iteration 1: 0.333333 - 0.5 i

         Iteration 2: 2.87509 - 1.61308 i

         Iteration 3: 2.14273 - 1.24178 i

         Iteration 4: 1.60889 - 0.987186 i

         Iteration 5: 1.25204 - 0.83956 i
```

Kincaid 3.3 #6) A succession of 60 monthly payments is made into an annuity. In the first to fifth years, the payments are, respectively, $200, $275, $312, $380, and $400. Just after the last payment has been made, the accumulated value of the annuity is $24,738. What was the monthly rate of interest? Use the secant method to find the zero of the polynomial that arises.

The polynomial for the value of the annuity is

$$V = \sum_{i=1}^{12} 200x^{60-i} + \sum_{i=1}^{12} 275x^{48-i} + \sum_{i=1}^{12} 312x^{36-i} + \sum_{i=1}^{12} 380x^{24-i} + \sum_{i=1}^{12} 400x^{12-i} - 24738 .$$

```
In[43]:= SecantIteration[F_, xl_, xll_] :=
           xl - F[xl] ( (xl - xll) / (F[xl] - F[xll]) );
         RunProgram[F_, a_, b_, iter_] :=
           Block[{xl = a, xll = b, temp = 0, i = 0},
            For[i = 0, i <= iter, i++,
             Print[StringExpression["Iteration "], i,
              StringExpression[": "], N[xl],
              StringExpression[" "], F[xl]];
             temp = SecantIteration[F, xll, xl];
             xll = xl; xl = temp]];
```

In[46]:=
$$f[x\_] := \sum_{i=1}^{12} 200\, x^{60-i} + \sum_{i=1}^{12} 275\, x^{48-i} + \sum_{i=1}^{12} 312\, x^{36-i} + \sum_{i=1}^{12} 380\, x^{24-i} + \sum_{i=1}^{12} 400\, x^{12-i} - 24738;$$

```
RunProgram[f, 1.3, 1.00, 10]
```

Iteration 0: 1.3 4.65157×10^{9}

Iteration 1: 1. -5933.82

Iteration 2: 1. -5933.63

Iteration 3: 1.01231 1541.82

Iteration 4: 1.00977 -288.021

Iteration 5: 1.01017 -11.3501

Iteration 6: 1.01019 0.0879096

Iteration 7: 1.01019 -0.0000265726

Iteration 8: 1.01019 -1.30967×10^{-10}

Iteration 9: 1.01019 2.18279×10^{-11}

Iteration 10: 1.01019 2.18279×10^{-11}