Summary: All Four Topology Matrices

Building Blocks for State-Space Averaged Model

Topology 11 (Both ON - Storage)

```
A11: Rows 1-6: Direct charging (L1, L2), reverse (L5, L6)
     Row 7: dvC1/dt = (-iL5)/C1
     Row 8: dvC3/dt = (-iL6)/C3
     Row 9: dvC0/dt = 0 (CPL separate)

Key: L1, L2 charge from Vin (no cap voltage)
     L5, L6 reverse charge through C1, C3
     Output isolated (no power transfer)
```

Topology 10 (S1 ON, S2 OFF)

```
A10: Row 1: L1 discharges via -vC3, -vC0
     Row 2: L2 direct charging
     Row 5: L5 reverse via -vC1
     Row 6: L6 forward via +vC0
     Row 7: dvC1/dt = (-iL5)/C1
     Row 8: dvC3/dt = iL1/C3
     Row 9: dvC0/dt = (iL1+iL6)/C0

Key: Phase 1 stores, Phase 2 transfers
     L1, L6 both contribute to output
```

Topology 01 (S1 OFF, S2 ON)

```
A01: Row 1: L1 direct charging
     Row 2: L2 discharges via -vC1, -vC0
     Row 5: L5 forward via +vC0
     Row 6: L6 reverse via -vC3
     Row 7: dvC1/dt = iL2/C1
     Row 8: dvC3/dt = (-iL6)/C3
     Row 9: dvC0/dt = (iL2+iL5)/C0

Key: Phase 2 stores, Phase 1 transfers
     L2, L5 both contribute to output
     Symmetric to Topology 10
```

Topology 00 (Both OFF - Max Transfer)

```
A00: Rows 1-2: Both L1, L2 discharge
     Rows 5-6: Both L5, L6 forward via +vC0
     Row 7: dvC1/dt = iL2/C1
     Row 8: dvC3/dt = iL1/C3
     Row 9: dvC0/dt = (iL1+iL2+iL5+iL6)/C0

Key: Both phases transfer simultaneously
     ALL FOUR active inductors contribute
     Maximum power delivery mode
```

Key Pattern Observations

- **Capacitor charging:** C1 charges from iL2 (when S1 OFF) or -iL5 (when S1 ON). C3 charges from iL1 (when S2 OFF) or -iL6 (when S2 ON).
- **Output current sources:** Topology 11: none (isolated). Topology 10/01: 2 inductors. Topology 00: 4 inductors.
- **Reverse vs. Forward:** When switch ON, output inductor reverse charges (negative current). When switch OFF, it discharges forward (positive contribution to output).
- **These 4 matrices are averaged:** $A_{avg} = w_{11} \cdot A_{11} + w_{10} \cdot A_{10} + w_{01} \cdot A_{01} + w_{00} \cdot A_{00}$ (next slide explains w_k weights)